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CHEMICAL LABORATORY, NEW YORK AGRICULTURAL EXPERIMENT STATION.

TENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK
Agricultural Experiment Station,

(GENEVA, ONTARIO CO.)

FOR THE YEAR 1891,

WITH REPORTS OF DIRECTOR AND OTHER OFFICERS.

TRANSMITTED TO THE LEGISLATURE APRIL, 1892.

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STATE OF NEW YORK.

No. 78.

IN ASSEMBLY,

April, 1892.

REPORT

OF THE

Board of Control of the New York Agricultural Experiment Station.

Hon. Robert P. Bush,
Speaker of the Assembly:

Sir.—I herewith transmit to the Legislature the Tenth Annual Report of the New York Agricultural Experiment Station.

Very respectfully,
Your obedient servant.
W. C. BARRY,
President of Board of Control.

334587

1891.

ORGANIZATION OF THE STATION

BOARD OF CONTROL.

ROSWELL P. FLOWER, *Governor*	Albany.
W. C. BARRY, *President*	Rochester, Monroe County.
JAMES McCANN	Elmira, Chemung County.
DANIEL BATCHELOR	Utica, Oneida County.
CHARLES JONES	Geneseo, Livingston County.
G. S. MILLER	Peterboro, Madison County.
GEORGE F. MILLS	Fonda, Montgomery County.
PHILIP N. NICHOLAS	Geneva, Ontario County.
ADRIAN TUTTLE	Watkins, Schuyler County.
S. H. HAMMOND	Geneva, Ontario County.

STATION OFFICERS.

Director	Dr. Peter Collier.
First Assistant	Wm. P. Wheeler.
Chemist	L. L. Van Slyke, Ph. D.
Horticulturist	S. A. Beach, B. S. A.
Assistant Chemist	C. G. Jenter, Ph. C.
Assistant Chemist	A. L. Knisely, B. S.
Assistant Chemist	S. Ando, Ph. C.
Assistant Chemist	W. H. Andrews.*
Assistant Chemist	B. L. Murray, Ph. C.*
Acting Horticulturist	C. E. Hunn.
Acting Pomologist	George W. Churchill.
Clerk and Stenographer	Frank E. Newton.

Post-office address: Geneva, Ontario county, N. Y.

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* Connected with Fertilizer Control.

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TENTH ANNUAL REPORT

OF THE

Board of Control of the New York State Agricultural Experiment Station.

REPORT OF THE EXECUTIVE COMMITTEE.

Since our last report your committee have held monthly meetings at the Station, often with other members of the board being present during our deliberations, and we have to report the following work as having been accomplished.

The new building for the chemical laboratory has been completed so far as called for under the contract with John Moore, Syracuse, N. Y., from plans prepared by E. A. Ellsworth, Holyoke, Mass. Such a laboratory building has been needed since the Station was established, but it was rendered imperatively necessary, in order to carry forward the work of fertilizer analysis, which was by law placed under the direction of the Station.

When fully completed this building will give ample accommodation, in its laboratories, for the chemical work of the Station, as also affording in the future, when the increasing demands of agriculture shall render it necessary to employ certain other specialists, convenient laboratories and rooms for their accommodation. At the present they are to be occupied for such of the assistants in the laboratory and other members of the staff as are unable to secure comfortable quarters convenient to the Station.

The entire building is warmed by the steam-heating apparatus manufactured by Dunning, of Geneva, and the results thus far are entirely satisfactory.

An abundant supply of water has been obtained by the extension of the mains of the water supply from the village of Geneva.

The filling and grading about the new laboratory has been completed so that the earth will have sufficiently settled during the winter to enable the grounds to be properly leveled and sodded in the spring. The sidewalk in front of the Station building has been continued to the railway cut and the roadway filled in to correspond with the entire front of the Station property. A vitrified tile drain has been laid with gradual fall from the laboratory through the orchard to Castle Creek.

Some needed repairs and modifications have been made in the cattle barns and poultry houses, and two new stalls for bulls and three box stalls for cattle have been added to the bull barn.

A new house for carrying forward experiments in breeding with poultry has been completed, since the other poultry sheds were all needed in the several feeding experiments which are being conducted.

The entire line of fences upon Castle Creek and Pre-emption road has been rebuilt and painted, and a permanent trellis been built in the experimental vineyard.

The graveling of the roads of the farm has been continued as opportunity has offered, and certain of the drains on the farm have been repaired.

A block of one-half an acre of several kinds of small nursery stock, cherries, plums, quinces, pears, apples and peaches, has been set out upon the experimental plats for the purpose of facilitating the work of Mr. Fairchild in his investigations of the various diseases which affect such stock, and this work has been from the first appreciated by the nurserymen who have extended to the Station all the needed aid in placing their own blocks of nursery stock at the disposal of Mr. Fairchild, and in making liberal contributions of such stock as was needed for his permanent block upon the Station grounds.

The upper room of the Dairy House has been fitted up for the manufacture of cheese, and the services of Messrs. Smith and Hall of the Dairy Commission were granted freely to supervise the manufacture of cheese, each step of which from the milk to the finished product and extending through the entire period of ripening has been under close and constant chemical supervision. The results promise to throw much light upon this important branch of agricultural industry.

We are pleased to see that the extended investigations of the several breeds of dairy cattle continues to arouse an increasing interest among our dairymen and the breeders of cattle, as is evidenced by the fact that four heifers and a bull of the Devon, a bull and heifer of the Guernsey, a heifer of the Jersey and two heifers of the Holstein-Friesian breed have been presented to the Station herd in order that the tests being made might be rendered as complete as possible.

The colored chart prepared by the director illustrating the food elements and fertilizing value of the various foods and farm products has necessitated a second edition to supply the demand, and several other Stations have secured supplies or contemplate so doing for distribution among their several constituents.

The correspondence of the Station has increased several hundred per cent during the few years past, and the applications for the bulletins of the Station daily increase. Fourteen bulletins have been issued since our last report, aggregating 346 pages, and the demand for its publications and for advice on all matters pertaining to agriculture gives conclusive testimony that the work of the Station is rapidly becoming more and more appreciated by the people, and by its increased dissemination of rapidly increasing value to the farmers of the State in whose behalf directly it is being done.

The value of the agricultural products of New York amount in the aggregate to, at least, $130,000,000 and probably to $150,000,000 annually, or upon an average from $340 to $400 a year for each of our 380,000 farmers.

The leading crops of New York are equal in value to 5.7 per cent of the total production of the United States; the farm animals to 5.8 per cent; number of milch cows to 9.7 per cent; while their value is 12.4 per cent of the value of all the cows in the United States.

It will be seen, therefore, that our State is not only in name but in comparison with other States, the Empire State, and that the work of our Experiment Station is one of the most important factors in enabling us to retain this proud pre-eminence.

France and Germany combined have nearly nine times the area and nearly fourteen times the population of New York State, and since the first Experiment Station was established in a Saxon village in 1851 they have so rapidly increased that there are at present 110 in these two countries, while every country in Europe is rapidly increasing their number of these institutions within their borders. Compared with Germany and France in proportion to area, New York should have twelve, and in proportion to population eight of these Stations, and especially when we consider the great diversity which exists in our State in soil, climate and in the character of its agricultural products, in which respect it is doubtful whether New York is surpassed by an equal area upon the globe.

Although perhaps it may not be wise to increase the number of these Stations, it would appear most desirable that everything should be done which may enable the Station, now for ten years established, to carry forward the work of investigation and accomplish that purpose for which it was organized, namely: "For the promotion of every branch of agriculture by scientific investigation and experiment."

In furtherance of this object and in the opinion of the director the following requirements appear of immediate necessity.

1. The completion of the basement laboratories in the new building.
2. Four residences for the married members of the staff.
3. A series of cold storage rooms for determination of the degree of temperature and moisture necessary for the proper preservation of the various fruits and berries.
4. A green-house and forcing-houses by which much of our horticultural work may be carried on the entire year.
5. An ice-house of sufficient capacity to serve the purpose of the Station.
6. The means of printing and distributing an edition of 1,000 of each of our bulletins in each county of the State.

The following statement presents, briefly, the work which has been carried forward in the several departments of the Station during the past year.

The work of the first assistant has been a continuation of his feeding experiments with poultry and swine. He has also had charge of the feeding of the dairy cattle, preparing rations for the different animals, including, on January 1, 1892, sixteen milch cows, six heifers, and seven bulls, these rations being arranged according to the appetite, condition, age and size of the several animals. The grain feed has been changed at intervals to supplement the forage and coarse fodder available through the several months of the year. He has also prepared bulletins in reference to his work, and continued his investigation with selected varieties of sorghum for the purpose of determining those varieties best suited for the production of sugar, syrup and forage in this State.

The chemist, Dr. Van Slyke, with his assistants, has carried forward the following:

1. Analysis of milk of dairy cattle of different breeds. This work involves the complete analysis each week of from sixteen to twenty samples of milk.

2. Determinations of fat in skim-milk, buttermilk and butter in connection with experiments with breeds of dairy cattle, involving from fifty to sixty determinations each week.

3. Microscopic examination of eight to ten milks each week.

4. Analysis of all foods used in various experiments at the Station.

5. Investigation of cheese:

(*a*) Experiments in the manufacture of cheese.

(*b*) The influence of composition of milk upon composition and yield of cheese.

(*c*) A study of the process of ripening cheese.

6. Analysis of fertilizers.

7. Analysis of chemical compounds and mixtures of chemical compounds used in spraying plants.

8. Miscellaneous analyses.

9. The chemist has attended and addressed the State Dairymen's Association at Owego, and given addresses on commercial fertilizers at farmer's institutes held at Batavia, Genesee county; Perry, Wyoming county; Geneseo, Livingston county; Lyons, Wayne county, and Albion, Orleans county, and has arranged for several other institutes yet to be held.

10. He has also prepared several bulletins covering the subject-matter of the investigations carried forward by him.

The work of the assistant horticulturist embraces the following:

Varietal tests of small fruits. One of the most complete collections in the United States.

Continued work on cross pollination of strawberries.

Tests of commercial fertilizers on small fruits.

Spraying with remedies for fungoid diseases of small fruits.

Tests of the newly introduced varieties of potatoes.

Tests of commercial fertilizers on potatoes.

Spraying with fungicides for the potato blight.

Tests of the vegetable novelties of late introduction.

Tests of commercial fertilizers on the yield of beans.

Forcing vegetables under glass.

Tests of fertilizers on forced tomatoes.

Planning an exhibit of plant diseases, with remedies, to be shown at fair.

Attendance on fairs with a large exhibit of fruits and vegetables, fertilizer and cattle foods.

Note taking.

The horticulturist, Professor Beach, who entered upon his duties at this Station November 1, 1891, has outlined the following work, a part of which is already under way:

Investigation of plant diseases for the purpose of determining inexpensive and effectual remedies.

Preparation of charts illustrating microscopic characteristics of fungus diseases of economic importance.

Investigation of the accumulation in the soil of compounds used for fungicides and insecticides, and the effect of such soils on vegetation.

Establishing an arboretum of native trees and shrubs.

Experiments in co-operation with the division of vegetable pathology, Washington, D. C., on the use of fungicides for pests of orchard fruits and nursery stock.

The work of Mr. Churchill, agriculturist, embraces the following:

Variety tests of grapes and orchard fruits, making a permanent record for each variety tested.

Investigation into the nature of seedling apples of this section of the State, and the collection of cions from promising varieties for propagation with the view of obtaining new varieties of value for commercial and home use, also for work in cross-fertilization.

Tests of varieties of grains, etc.

Fertilizer experiments with corn on farm.

Continuation of fertilizer experiments with corn on plats.

Routine work, involving the superintendence of labor on the farm and plats, etc.,

The clerk and stenographer (Mr. Newton) has had his time more than filled by the increased correspondence of the Station, the mailing of bulletins and other publications referred to elsewhere in this report, labor involved in the entire charge of the bills, and the regular routine work of the office.

The following statement of the number of letters written, of which copies have been kept, will show the increase in the correspondence of the Station since its establishment:

1882	644
1883	642
1884	218
1885	401
1886	600
1887	405
1888	1,204
1889	1,209
1890	1,360
1891	1,561

The bulletin list has rapidly increased and almost entirely through personal application of the farmers, and without effort thus far by the Station, although it is most desirable that such effort should be made; so soon as the means are provided for the printing and distributing of a much larger edition.

Sometimes from fifty to seventy-five names have been added to the bulletin list in a single day, and the increase during the last nine days, January 1–10, has been 100. During the past year the number of names added to the list has been equal to those of the first eight years. At present there are 5,500 names on the bulletin list

JAMES McCANN,
CHARLES JONES,
GERRITT S. MILLER,
P. N. NICHOLAS,
S. H. HAMMOND,
Executive Committee.

GENEVA, NEW YORK, *January* 1, 1892.

TREASURER'S REPORT.

GENEVA, N. Y., *October* 30, 1891.

To the Board of Control of the New York Agricultural Experiment Station:

As treasurer of the Board of Control, I do respectfully report:

That I have received from the Treasurer of the State of New York, for the twelve months ending September 30, 1891	$20,000 00
That the balance on hand October 30, 1890, was	36 99
Total	$20,036 99

And I do further report that I have expended during the twelve months ending September 30, 1891, $20,018.30, vouchers for which, duly audited by the special auditing committee of the Board of Control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Farm	$420 80
Farm implements and tools	18 55
Freight, cartage and express	276 42
Fuel	519 14
Furniture	4 41
Labor	6,296 31
Laboratory department	1,003 03
Library	63 25
Live stock	447 00
Meteorological department	4 75
Permanent improvement	529 28

Postage expenses	$326 84
Printing	494 25
Repairs	250 04
Salaries	6,873 70
Scientific apparatus	8 18
Stationery	74 62
Sundries	80 08
Supplies	1,449 43
Tenement-houses	100 00
Fuel	268 83
Board of Control	509 39
	$20,018 30
Balance on hand	18 69
Total	$20,036 99

And I do further report that I have expended $2,311, the balance, September 30, 1890, of the special appropriation of $10,000, vouchers for which, duly audited by the special auditing committee of the Board of Control, have been furnished the Comptroller of the State of New York.

And I do further report that I have received from the Treasurer of the State of New York on account of fertilizer control, $15,000; that the balance on hand September 30, 1890, was $2, 792.28; total, 17,792.28.

And I do further report that I have expended on this account $13,560.98, vouchers for which, duly audited by the special auditing committee of the Board of Control, have been furnished the Comptroller of the State of New York.

Properly classified the expenditure has been as follows:

Salaries	$2,704 92
Fixtures and apparatus	4 00
Securing samples	987 01
Bulletins	799 98
Rent of building	395 65
Laboratory	6,866 84
Repairs	19 32

Supplies	$924 78
Postage and printing	847 83
Freight cartage and express	10 65
	$13,560 98
Balance on hand	4,231 30
Total	$17,792 28

WILLIAM O'HANLON,
Treasurer.

DIRECTOR'S REPORT.[*]

To the Board of Control of the New York Agricultural Experiment Station:

GENTLEMEN.— I herewith submit the tenth annual report of the Experiment Station for the calendar year 1891.

The report of the executive committee of the Board of Control will show what has been accomplished under their direction during the past year in the erection of the new chemical laboratory and in the necessary repairs and improvements to buildings, fences and roads. Their report presents also a general statement of the work which has been carried forward by the different members of the staff, and their opinion as to what additional facilities are demanded in order to render the work of the Station of still greater value to the farmers of the State.

BULLETINS PUBLISHED DURING THE YEAR 1891.

During 1891 there have been distributed twelve bulletins, containing an aggregate of 326 pages, upon the following subjects:

Bulletin No. 26.— *January*, 1891.

New York State Fertilizer Control:
  Outline of the history of commercial fertilizers.
  General principles underlying the use of commercial fertilizers.

Bulletin No. 27.—*February*, 1891.

New York State Fertilizer Control:
  General principles underlying the use of fertilizers.

Bulletin No. 28.— *April*, 1891.

Pig feeding experiments with coarse foods:
  Results with prickly comfrey.

---

[*] Peter Collier, A. M., M. D., Ph. D.

Oat and pea forage and red clover.
Clover with and without salt.
Sorghum and mangolds.

Bulletin No. 29.— *April*, 1891.

Feeding experiments with laying hens:
More and less nitrogenous rations.
Difference in the general health.
Products of eggs compared.
Results for several periods.
Average results tabulated.
Some general conclusions.
Results of dissection.
Comments.

Bulletin No. 30.— *May*, 1891.

Cabbage and cauliflower:
A comparative test of imported versus American grown seed.
Tomatoes:
A comparison of yields of several varieties grown by different methods.
A description of varieties.
Tests with seed from green and ripe fruits.

Bulletin No. 31.— *May*, 1891.

Commercial valuation of the food and fertilizing constituents of feeding materials.

Bulletin No. 32.— ——

New York State Fertilizer Control:
Description of materials used in making commercial fertilizers.
Fertilizing materials produced on farms.
Fertilizing composition and valuation of various products.

Bulletin No. 33.— *July*, 1891.

New York State Fertilizer Control:
Explanation of terms of chemical analysis.
Commercial valuations of fertilizers.
Composition of various chemical compounds.

Bulletin No. 34.— *August*, 1891.

Comparison of dairy breeds of cattle with reference to production of butter.

Bulletin No. 35.— *August,* 1891.

Some of the most common fungi and insects with preventives.

Bulletin No 36.— *September,* 1891.

Small fruits:
  The strawberry:
    Insect enemies of the strawberry.
  The raspberry:
    Diseases of the raspberry.
    Insect enemies of the raspberry.
  The blackberry.
  The currant:
    Insect enemies of the currant.
  The gooseberry:
    Gooseberry mildew.

Bulletin No. 37.—*November,* 1891.

Investigation of cheese:
  Experiments in the manufacture of cheese.
  Influence of composition of milk on composition and yield of cheese.
  A study of the process of ripening of cheese.

GIFTS TO THE STATION.

January 21. Genesee Valley Salt Company, Piffard, N. Y., 448 pounds of fine salt.

January 27. Cleveland Linseed Oil Company, Cleveland, O., five bags of linseed meal.

February 2. Francis Brill, Hempstead, N. Y., cabbage and cauliflower seed.

February 9. J. M. Vandervort & Son, New Antioch, O., seedlings of the pear and apple.

February 16. W. H. Hallock & Co., Queens, N. Y., a collection of vegetable seeds.

February 20. Dr. E. Lewis Sturtevant, South Framingham, Mass., some Christiana melon seed.

February 23. Joel Horner & Son, Delair, N. J., melon and tomato seed.

March 17. The Steele Brothers Company, Toronto, Canada, spring wheat and some carrot seed.

March 20. United States Department of Agriculture, Washington, willow cuttings, Chinese potato bulblets, sorghum seed, and conifer seeds.

March 27. Royal Church, Harrisonville, O., raspberry plants.

March 31. T. Greiner, La Salle, N. Y., German grafting wax.

April 1. R. D. Luther, Fredonia, N. Y., plants of the Luther blackberry.

April 6. Stephen Reeves, Marion, N. Y., seedling pear cions.

April 13. Conklin & Mersereau, Binghamton, N. Y., seed corn.

April 14. The Mark W. Johnson Seed Company, Atlanta, Ga., seed beans.

April 15. Samuel Wilson, Mechanicsville, Penn., peach trees, strawberry and dewberry plants, and wheat.

April 15. Charles Wright, Seaford, Del., peach trees.

April 15. George L. Miller, Stockton, O., strawberry plants.

April 17. Charles Mills, Fairmont, N. Y., raspberry plants, and a seedling currant.

April 17. William H. Maule, Philadelphia, Penn., three pounds of potatoes.

April 17. A. H. Griesa, Lawrence, Kans., red raspberry plants.

April 18. J. T. Thompson, Oneida, N. Y., seedling raspberry plants.

April 20. Of the American Glucose Co., Buffalo, N. Y., one ton of No. 1 patent process feed.

April 20. F. Barteldes & Co., Lawrence, Kans., vegetable seeds.

April 21. George W. P. Jerrard, Caribou, Me., potatoes, beans, squashes.

April 27. John Hazelton, Delaware, O., strawberry plants.

April 28. C. W. Minot, Burlington, Vt., twelve kinds of potatoes.

April 29. W. S. Powell & Co., Baltimore, Md., fungicides.

April 30. David Feight, Dayton, O., strawberry plants.

April 30. H. A. Jones, Himrods, N. Y., pear trees.

May 1. S. J. Smith, Manchester, N. Y., beans.

May 8. D. J. Piper, Forreston, Ill., strawberry plants.

May 8. J. R. Michelson, Oak's Corners, N. Y., raspberry plants.

May 9. Vilmorin, Andrieux et Cie., Paris, France, vegetable and flower seeds.

May 14. C. S. Curtice Company, Portland, N. Y., grape vines.

May 20. Jerome B. Rice & Co., Cambridge, N. Y., vegetable seed.

May 29. Alfred Boyd, Toronto, Canada, flax seed.

June 12. C. H. Bootes, Potter Centre, N. Y., German carp.

June 27. Joshua I. Maxwell, Geneva, N. Y., Holstein-Friesian Herd Book, Volume 8.

Ellwanger & Barry, Rochester, N. Y., clematis and ampelopsis plants, and fifty roses.

December 11. Dr. E. A. Sheldon, Oswego, N. Y., White Leghorn cockerel.

NEWSPAPERS AND PERIODICALS PRESENTED TO THE STATION.

Agricultural Epitomist, Indianapolis, Ind.
Agriculturist and Live Stock Gazette, Jamesburg, N. J.
Albany Weekly Journal, Albany, N. Y.
American Agriculturist, New York, N. Y.
American Cultivator, Boston, Mass.
American Dairyman, New York, N. Y.
American Farmer, Middletown, Md.
American Grange Bulletin, Cincinnati, Ohio.
American Grocer, New York, N. Y.
American Homestead, Omaha, Neb.
American Stock-Keeper, Boston, Mass.
Baltimore Weekly Sun, Baltimore, Md.
Boston Weekly Globe, Boston, Mass.
Breeders' Gazette, Chicago, Ill.
Canadian Entomologist, Fort Hope, Canada.
Chautauqua Farmer, Dunkirk, N. Y.
Cultivator and Country Gentleman, Albany, N. Y.
Detroit Free Press, Detroit, Mich.
Deutsche Wolkerie-Zeitung, Berlin, Germany.
Every Week, Angelica, N. Y.
Farmers' Advocate, London, Canada.
Farm and Fireside, Philadelphia, Penn.
Farm and Home, Springfield, Mass.
Farmers' Home, Dayton, Ohio.
Farm Journal, Philadelphia, Penn.
Farm Life, Rochester, N. Y.
Farm, Stock and Home, Minneapolis, Minn.
German Agricultural and Horticultural Journal, New York, N. Y.
Hoard's Dairyman, Fort Atkinson, Wis.

Holstein-Friesian Register, Boston, Mass.
Home and Farm, Louisville, Ky.
Horticultural Art Journal, Rochester, N. Y.
Hospodar, Omaha, Neb.
Husbandman, Binghamton, N. Y.
Industrial American, Lexington, Ky.
Jersey Bulletin, Indianapolis, Ind.
Ladies' Home Companion, Philadelphia, Penn.
Louisiana Planter and Sugar Manufacturer, New Orleans, La.
Maritime Agriculturist, St. John, N. B.
Maryland Farmer, Baltimore, Md.
Milk Reporter and Daily Record, New York, N. Y.
Mirror and Farmer, Manchester, N. H.
Monthly Weather Review, Washington, D. C.
National Provisioner, New York, N. Y.
Nebraska Bee-Keeper, York, Neb.
Nebraska Farmer, Lincoln, Neb.
New Dairy, New York, N. Y.
New England Farmer, Boston, Mass.
Northwestern Farmer, St. Paul, Minn.
Orange County Farmer, Port, Jervis, N. Y.
Orange Judd Farmer, Chicago, Ill.
Orchard and Garden, Little Silver, N. J.
Our Country Home, New York, N. Y.
Peninsula Farmer, Federalsburg, Md.
Poultry Monthly, Albany, N. Y.
Practical Farmer, Philadelphia, Penn.
Rural New Yorker, New York, N. Y.
Shorthorn Gazette, Indianapolis, Ind.
Southern Cultivator, Atlanta, Ga.
Sugar Beet, Philadelphia, Penn.
Sugar Bowl and Farm Journal, New Orleans, La.
Vick's Illustrated Monthly Magazine, Rochester, N. Y.
West American Scientist, San Diego, Cal.
Western Breeder, St. Joseph, Mo.
Western Garden and Poultry Journal, Des Moines, Iowa.
Western Plowman, Moline, Ill.
Western Resources, Lincoln, Neb.
World, New York, N. Y.

THE AGRICULTURE OF THE EMPIRE STATE.

The New York Agricultural Experiment Station was wisely established, as is stated in the words of the act "For the purpose of promoting every branch of agriculture by scientific investigation and experiment."

In 1851 the first experiment station was established at Mockern in Saxony. To-day there are in Germany and France alone 110. In proportion to area New York should have thirteen, in proportion to population, eight.

But it may be urged that a comparison with these countries of the old world will hardly apply to us, let us therefore present a few statistics concerning the Empire State as compared with its nearest neighbors, the New England and Middle States.

The following statistics are compiled from the annual reports of the Department of Agriculture, 1879 to 1888:

AVERAGE ACREAGE YIELD PRINCIPAL FARM CROPS, 1879 to 1889.

	Corn, bushels.	Wheat, bushels.	Rye, bushels.	Oats, bushels.	Barley, bushels.	B'kwheat, bushels.	Potatoes, bushels.	Tobacco, pounds.	Hay, tons.
Maine	31.76	13.79	13.45	28.28	21.87	19.35	98.70	....	.98
New Hampshire	32.34	14.00	11.18	32.79	21.68	17.90	91.60	1,517.2	.94
Vermont	32.66	16.76	14.23	33.28	24.88	18.69	102.61	1,489.5	1.06
Massachusetts	31.75	16.50	14.06	30.28	23.05	14.00	95.34	1,487.1	1.13
Rhode Island	30.18	12.80	12.03	27.73	23.43	10.70	92.07	....	1.04
Connecticut	29.91	16.87	13.75	27.85	21.60	12.31	82.06	1,421.0	1.03
New Jersey	30.86	12.86	10.70	27.59	17.24	13.56	78.59	1,102.5	1.11
Maryland	25.16	12.48	10.53	20.53	25.20	13.74	70.03	658.0	1.09
Delaware	20.21	11.71	9.13	21.40	......	14.32	......	678.4	1.04
Pennsylvania	31.55	12.94	10.73	28.56	20.35	13.87	75.97	1,231.4	1.16
Average	29.64	14.07	11.98	27.83	19.94	14.84	78.70	1,198.0	1.06
New York	30.22	14.84	12.05	29.06	22.89	14.06	80.32	1,342.6	1.12
New York's relative position	7th	4th	5th	4th	5th	5th	7th	5th	3d

It is gratifying to observe that for ten years the average acreage yield of the principal farm crops in New York has in every crop exceeded the average of the New England and Middle States, as the above table shows; but, as will be seen, New York stood upon acreage fifth in the list of these states in its average yield.

In 1888 the above crops had an acreage of 8,967,318 and a value of $121,333,857, while all the New England and Middle States without New York and Pennsylvania had an aggregate acreage of 6,672,642 acres, and their products of the above are valued at $94,321,795; only seventy-eight per cent of area and seventy-four per cent of value of New York.

Had New York stood first of the New England and Middle States instead of averaging fifth she would have received an aggregate of $39,573,827.86 more for these leading crops than she did. Does anybody believe our lands to be less fertile, our people generally less clever than those of the New England and Middle States.

The New England States and the Middle States excepting New York and Pennsylvania have in all nine Experiment Stations. Had New York a number proportional to its acres of cultivated land it would have eleven. Had it Stations in proportion to the aggregate value of its leading crops, it would have twelve.

The following table presents a comparison of certain of the agricultural statistics of New York with the New England and Middle States, excepting Pennsylvania, an examination of which may surprise many who have not had their attention directed to the matter.

COMPARATIVE STATISTICS OF NEW YORK AND THE NEW ENGLAND AND MIDDLE STATES.

	Number acres in leading crops 1888.	Total value of leading crops 1888.	Number of farms.	Number of farmers.	Number of cows.	Value of cows.	Acres improved in farms.	Acres un-improved in farms.	Total acres in farms.	Area in square miles.	Per cent in farms.
Maine	1,594,252	$20,136,946	64,309	82,130	175,940	$4,398,725	3,484,908	3,067,670	6,552,578	33,040	31
New Hampshire	802,184	9,574,799	32,181	44,490	103,011	2,846,194	2,308,112	1,413,061	3,721,173	9,365	62
Vermont	1,303,476	14,592,101	35,522	55,251	234,642	5,572,748	3,286,461	1,596,127	4,882,588	9,565	80
Massachusetts	792,638	14,905,768	38,406	64,973	174,729	5,678,693	2,128,311	1,230,768	3,359,079	8,315	63
Rock Island	132,755	2,394,387	6,216	10,945	24,041	745,271	298,486	216,327	514,813	1,250	64
Connecticut	741,800	13,112,938	30,598	44,026	134,897	4,192,599	1,642,188	811,353	2,453,541	4,990	77
New Jersey	1,305,537	19,604,856	34,307	59,214	183,493	6,325,004	2,096,297	833,476	2,929,773	7,815	59
Delaware	398,877	4,062,271	8,749	17,849	29,543	812,433	746,958	343,287	1,090,245	2,050	83
Maryland	1,840,854	22,914,300	40,517	90,927	141,826	3,454,881	3,342,700	1,777.131	5,119,831	12,210	66
Total	8,912,373	$121,298,366	290,805	469,805	1,202,122	$34,026,548	19,334,421	11,289,200	30,623,621	88,600	Ave. 54
New York	8,967,318	121,333,857	241,058	377,460	1,552,373	43,637,205	17,717,862	6,062,892	23,780,754	49,170	76
Ratio	106	100.3	82.8	80.3	129.1	128.3	91.6	53.7	77.7	55.5	141

But not only is our State imperial in its extent of area and the aggregate of its productions, but also, and this is a most pertinent point of the discussion, in the great diversity of its agricultural products.

William C. Barry told us in his address as President of the Western New York Horticultural Society that there were in New York 43,350 acres in vineyards. That in 1889 the grapes sold in New York amounted to $5,512,215 and those of California to $4,745,097. New York equals sixteen per cent more.

Our dairy cattle numbered January, 1892, 1,552,217, valued at $40,637,041, nine and one-half per cent of the total number and eleven and one-half per cent of the aggregate value of all the dairy cattle in the United States.

It is estimated that the capital invested in the dairy industry in the State of New York is $400,000,000.

For simply protecting the products of this industry the sum of $95,000 has been placed upon the appropriation bill.

As to all police supervision, we may say in the words of Burns, "what's done we partly may compute, we know not what's resisted." But with all which has been accomplished by this expenditure we will all agree that it has not brought substantial relief to the dairymen of our state in increased prosperity and enhanced prices.

We do not wish to be understood as objecting or even offering to object to this appropriation of $95,000, but to our minds it is clear that had an equal sum been expended in educating and informing our dairymen as to the details and the economies of their business, we feel confident that their products might bid defiance to oleomargarine and all its allies in our markets, and this dairy industry instead of being depressed might soon become one of the most profitable industries of the country.

Let us briefly point out how this may be accomplished.

1. We have, mainly as gifts outright to the State from the several breeding associations of the country one of the finest herds of cattle ever brought together, consisting of: Five Holsteins, five Ayrshires, four American Holderness, six Guernseys, five Jerseys, three Short Horns and five Devons.

These came from herds in New York, Pennsylvania, Vermont, Massachusetts, Connecticut and Rhode Island, and are all registered animals of finest blood. They are fed the same food, receive the same care, and yet in cost of production of milk the best is to poorest as 100 is to 162, while in cost of production of butter the best is to the poorest as 100 is to 196, while one may be among the least profitable for milk and among the most profitable for butter production.

The annual average of our dairy cows in butter is from 125 to 127 pounds, but we have the report of one dairyman whose herd averaged last year 394 pounds of butter per cow, and he explains why it was not fifty pounds more, and says his herd for the past sixteen years has not failed to yield him an average of 300 pounds per cow and a net profit of over fifty dollars each per annum. On the other hand we find that seventy-five per cent of the cows in one of our best dairy sections of the State have not paid their cost.

2. Two of our leading dairymen, each getting an average butter product of over 300 pounds per annum per cow, feed rations costing respectively sixteen and thirty-one and one-half cents daily per cow, but a saving of one cent per day in the rations of our dairy animals in this State is $15,522 per day or $5,680,000 annually.

3. We have proved at the Experiment Station at Geneva that milch cows gave back in the liquid and solid manure a value in fertilizing constituents, nitrogen, potash and phosphoric acid, equal to seventy per cent of the market value of the feed fed the animals and that three-fifths of this was in the liquid portion. Now the milch cows of this State annually consume, at thirty-six dollars each, $56,000,000 worth of food, seventy per cent of which is $39,200,000; we have besides 1,462,872 horses, mules and oxen costing quite as much more, as also 2,234,747 sheep and hogs. It is safe to estimate the manure made upon the farms of this State at $100,000,000 of which it is also safe to estimate that one-half or two-thirds is allowed to waste.

We have sought to impress these facts upon our farmers by means of a colored chart which gives the relative amount of these fertilizing and food constituents in the several farm products and cattle foods. These charts have been distributed to granges, agricultural societies and farmers' clubs throughout the State, and have been ordered by Stations of several other States for distribution in those States.

If we can impress our farmers with the importance of this single point in their practice we shall have repaid many hundredfold all the expense of our Experiment Station.

In connection with this subject it is well to mention that we annually buy in this State four or five million dollars' worth of commercial fertilizers and through the supervision of this business on the part of the Experiment Stations of the country it has resulted that in their purchase of $4,000,000 worth of these products, the farmers of this State are able to save at least $6,000,000 annually.

This may appear a paradox but is literally true, since such has been the improvement in quality and reduction in price of these commercial fertilizers during the past twenty years, that the farmers of to-day can for $4,000,000 buy the same aggregate of nitrogen, potash and phosphoric acid, for which they would have had to pay ten or eleven million dollars twenty years ago. While business competition has been largely the cause of this improvement in quality and reduction in price, such competition has arisen through the increased information concerning these products which the Experiment Stations have diffused among the people.

To illustrate some of our work a sample of beans from the Genesee Valley was recently received at the Station. Many doubtless know that New York produces nearly one-half (42.4 per cent) of the bean crop of the United States.

This malady affecting these beans might result in the entire destruction of this industry. At present it is of little concern, but we can perhaps remember the first Colorado beetle we ever saw, which since has caused a loss of hundreds of millions of dollars to this country.

A delegation of grape growers visited the Station lately to confer with reference to certain diseases of the vine, foliage and fruit, which were putting in an appearance in the vineyards. As evidence of the amazing rapidity of these invasions of disease, one gentleman who had inspected a diseased vineyard in one section of the State reached home on a Saturday and carefully inspected his vines to see if this new disease had appeared in his own vineyard, and said that he easily carried in one hand the vines and leaves he found infested, but the following Monday, as he said, a hay rack would not have held the diseased vines, so rapid had been the progress of this disease.

The gooseberry as is known has largely disappeared from our market owing to the mildew, and yet at the Experiment Station we have for successive years grown it absolutely free from any trace of mildew upon either foliage or fruit.

Many have doubtless heard of how suddenly the black-knot invaded and destroyed several thousand plum trees for Mr. George T. Powell, apparently free one year before; and yet after half a century of the ravages of this destructive pest of the fruit grower it is but recently that its true character and life-history has become known and the means of its destruction determined.

Another line of investigation has been developed within recent years and it is found that many of our prevalent diseases in both the animal and vegetable kingdoms are due to minute forms of life now known as bacteria, not only this but many of the commonest phenomena of farm life are found to be attributable to these bacteria.

Agricultural science need never lack friends so long as the memory of Pasteur and his achievements remains. It may be recalled how not many years ago a unique consignment passed through this State consisting of two car-loads of silk-worm eggs en-route from Japan to Italy, valued at $250,000, the commercial result wholly of Pasteur's investigations.

In carrying forward the work for which the Station was organized, it is obviously impossible to enter upon every line of investigation at once, but it is equally clear that no "branch of the agricultural industry" is to be permanently denied the benefits which may follow "scientific investigation and experiment." It is obvious therefore, that such a Station, if it is to accomplish that for which it was established, must gradually reach out into new fields of inquiry, extend its researches into new branches of agriculture, and be prepared to meet new problems which are constantly presenting themselves to the farmer; in short it must be a growing institution, and must be constantly presenting its needs for the means of such development.

During the past four years, the Legislature has generously responded to these demands, and the increased work done appears to have met the cordial approval of those who have been cognizant of the work, and for whom directly it has been done. We know of no expenditure of public money which can result in greater pecuniary return to our people.

We need hardly say that for the work of such investigation as the demands of modern agriculture have forced upon us, there is need for the highest skill which the State can secure. For the solution of the problem of that silk-worm disease, now known as Pebrine, the president of the French academy selected his most esteemed pupil and friend. The results secured at our Experiment Stations, the lessons taught by those who are engaged in these investigations, are to be at once carried into practice by those of our farmers who seek guidance and counsel from these Stations, and the very best service which can be rendered is none too good for the important work, and for such service we must expect to pay as liberally at least as do our colleges, universities and private corporations for similar service.

During the past year there has been the most gratifying evidence that the work at the Station is becoming more and more highly appreciated at home and abroad. The increase in the correspondence and in requests for bulletins has never been so great as during the past year, and daily letters testify to the practical value of our work.

There is another matter to which it is well to call attention. New York consumes annually nearly or quite $20,000,000 worth of sugar, syrup and molasses.

In 1811 Napoleon practically prohibited the introduction of sugar and molasses into France, and appropriated 1,000,000 francs for the establishment of six experiment stations in which the growing of beets and the manufacture of sugar therefrom should be taught, as he expressed it, "conformably to the processes of the chemists." From such beginning this industry has extended until to-day three-fifths of the world's commercial supply of sugar is made from the beet.

We think it would be wise to investigate the capability of the soils and climates of this State for the production of beets suitable for the production of sugar. There is no need to enter upon its manufacture, since the economic details of this process are as thoroughly understood as the manufacture of flour from wheat.

But we presume few have kept up with the recent progress of sugar manufacture from another plant, sorghum, to which it is desirable to call attention. Thus far no experiments have been made in this State with sorghum which by the wildest imagination could be called scientific, looking to it as a possible source of our sugar supply.

Several years ago Dr. Goessmann, the director of the Massachusetts Agricultural Experiment Station at Amherst, Massachusetts, in a report which was published in the transactions of the New York Agricultural Society, said:

"When the beet root was first cultivated for the manufacture of sugar, it contained only from seven to eight per cent of sugar, but by the application of proper care to the cultivation and to selecting the best specimens for seed, the percentage was increased to from eleven to twelve in some species. Should it be possible to increase the percentage of the sugar in the sorghum in the same ratio, its successful cultivation would become an accomplished fact; and our farmers, aided by their superior skill, more perfect machinery and many other advantages afforded by this country, would be able to compete successfully with the planters of the West Indies."

The *American Grocer*, of New York, in an editorial in its issue of November 11, 1891, says:

"We believe if private capital could be more extensively employed, and the formation of stock companies by adventurers who are less interested in sorghum than in making money by selling stock, done away with, and sorghum sugar manufacture would soon become a great national industry.

The *National Provisioner*, of New York, under date of December 5, 1891, says, editorially:

"There seems to be no reason," says Secretary Rusk, "why we should not look forward with confidence to the day when the $100,000,000 paid by Americans to foreign producers for sugar shall be turned into the pockets of our own people!" "Very true, Mr. Secretary," adds the editor, "and others besides you will be grievously disappointed if the process of extracting sugar from sorghum proves anything short of absolute success."

A letter to this Station from one in charge of sorghum experiments under the United States Department of Agriculture in Kansas, says:

"I believe now we can expect field cane to have an average of fourteen per cent of sugar in the juice, and Dr. Wiley says we can now expect 200 pounds of sugar from a ton of such cane."

A recent letter from a veteran sorghum grower and manufacturer of Minnesota, of thirty-five years' experience, says that last season, which was for growing sorghum the worst but one in thirty-five years, he paid two dollars a ton for the unstripped cane (an excellent price to the farmer growing it) and sold his syrup at forty cents a gallon and his sugar at 4.1 cents, netting each day of ten hours fifty-one dollars and forty cents.

The State Inspector of Kansas-made sugar, officially reports as follows concerning the Fort Scott Sorghum Sugar Factory:

"The Fort Scott Company contracted for 1,000 acres of cane, all of which was delivered. The crop was backward and of inferior quality compared with former years, but notwithstanding the fact that over 1,000 tons less of cane were worked for sugar than last year (1890) the amount of sugar manufactured exceeded last year's (1890) crop by 101,439 pounds. The total value of the year's product was $35,172. The total cost of production was $23,803.22, leaving a profit of $11,368.78." The inspector continues as follows: "The results obtained at Fort Scott under unfavorable circumstances demonstrate that the business can now be successfully conducted when the required conditions are fully complied with. Because there has been a failure to realize a profit at other places indicates that there has been bad management."

Without making any recommendation we would add that for four successive years we have grown at the Experiment Station several varieties of sorghum which averaged a content of sugar equal to the average of sugar cane in Louisiana.

The immediate and pressing needs of the Station to enable the carrying forward of the work which is demanded are as follows:

1. The completion and equipment of the new laboratory, estimated at $6,000.

2. The building of at least four houses for the accommodation of married members of the staff, $12,000.

3. Greenhouse and forcing houses in order to carry on work during winter in horticultural investigation, $8,000.

4. Cold storage-room, $4,500.

5. An ice-house, $500.

6. Printing 50,000 bulletins each month, $8,250; postage on 600,000 at one cent, $6,000; envelopes, 600,000 at three dollars and twenty cents, $1,920; mailing lists, $500; two mailing clerks at forty dollars a month, $960; total, $48,630.

The above items are substantially the same which it will be seen are recommended by the executive committee in their report.

INVESTIGATION OF THE SEVERAL BREEDS OF DAIRY CATTLE.

"In some scientific books the opinion was confidently put forth that if you increase the quantity of fat in the fodder you increase the relative quantity of butter in the milk. It is a matter of some consequence to know these things. When we have made four or five series of careful experiments in which we have weighed the milk in all its parts, the fat, caseine, the sugar and salts, separately, and have weighed the food in all its parts in the same manner, so that we know exactly what went into the cow and what came out of her, we are in a position to say what are the facts. It is not my opinion or your opinion; is is not a case of "I guess so," or "It can't be otherwise;" all that has little real value unless there be behind it an evident basis of impregnable fact."— Prof. Samuel W. Johnson, Yale College, Conn., 1873.

The above quotation is from an address given many years ago by one to whom agricultural science in America, at least, is more greatly indebted than to any other of the hundreds who have ably contributed to its advancement; and since the above-quoted remarks were made very many investigations, more or less complete, have been undertaken, looking to the solution by careful experiment of the comprehensive question suggested by this eminent scientist.

Less specific but of the same tenor were those words of Sir Humphrey Davy who said that "nothing is more needed in agriculture than experiments in which all the circumstances are minutely and scientifically detailed. This art will advance with rapidity in proportion as it becomes exact in its methods."

Nothing that I can say could add to the words of these eminent authorities, and those engaged in the work of investigation will be most successful who follow most closely the general and specific instructions above recorded.

The investigations of this problem planned at this Station have from the first been upon the lines so clearly laid down, confident that in no other way can a satisfactory conclusion be secured, and it is along these lines that it is intended to continue until an accumulation of testimony shall have been secured sufficient to reconcile many at present apparently conflicting opinions, to confirm many others which appear to be conclusive, as also to determine many questions intimately associated with the leading problems, concerning which at present no rule of practice exists founded upon well ascertained experimental data.

Of such immense practical importance is this investigation and of such scientific interest that it should be entered upon and carried forward with as little delay as possible, and yet so manifold and intricate are the questions involved in its discussion that a speedy conclusion of the whole matter can only be hoped for as the result of prolonged investigation, but the following record of results already accomplished, and of data already secured which shall perhaps find its greatest value as a basis for future conclusions, is presented, confident that the work will commend itself to our intelligent dairymen as being in the right direction.

In this investigation full-blooded registered animals were used as follows:

One Holstein-Friesian.
Four Ayrshires.
Three Jerseys.
Two American Holderness.
Two Guernseys.
Two Devons.

The above fourteen cows were in their first period of lactation. so that whatever results may appear to be established are such only as apply to the age of the animals experimented with, and the conditions which surrounded them at the Station.

All food and water was taken in the stable and upon every fair day exercise was allowed them in the yard.

Since certain of the conclusions which appear to be established from the investigations are not only of scientific interest and great practical importance, but also at variance with general belief in certain points, it has appeared desirable that, so far as practicable, the data upon which these conclusions are based should be presented in order that those interested in this investigation should themselves be able to judge to what extent the conclusions are sustained by the facts.

It will be seen that there are certain general principles which apply to every breed and to every individual, while there are to be seen certain characteristics peculiar to each of the several breeds.

A discussion of the data will be reserved mainly until the data thus far secured has been presented.

The following table gives the names of the animals, their breed, date of birth, time of calving and age at time of calving.

NAME OF COW.	When born.	Date of calving.	Age at calving.
Ayrshires.			Days.
Queen Duchess........	Feb. 21, 1888	July 24, 1890	884
Junietta Peerless......	July 26, 1888	Feb. 4, 1891	923
Manton Belle	June 16, 1888	Dec. 11, 1890	908
Miss Flow 5th	March 1, 1888	Feb. 5, 1890	706
Jerseys.			
Gilderbloom	April 6, 1888	Sept. 9, 1890	886
Countess Flavia	May 14, 1888	April 19, 1890	705
Barbara Allen.........	Aug. 18, 1888	Aug. 29, 1890	741
American Holderness.			
Nellie 6th	Aug. 10, 1888	Sept. 13, 1890	764
Maggie 6th	Aug. 15, 1888	Sept. 25, 1890	771
Guernseys.			
Rosette Ford	May 10, 1888	Nov. 14, 1890	918
Oriole	Aug. 25, 1888	Dec. 7, 1890	834
Devons.			
Ione	March 5, 1888	March 7, 1891	1,097
Genevie's Gift.........	Sept. 19, 1889	May 15, 1891	603
Holstein-Friesians			
Esel 2d...............	June 22, 1888	July 16, 1890	754
Averages	July 8, 1888	Oct. 28, 1890	821

The following table gives the kind and amount of each food eaten by each animal during each month of the experiment, and it will serve as a guide to those who may desire, during the different months of the year, to supply their animals with a similar ration.

Letters of inquiry are frequently addressed to the Station asking for information as to the rations needed for production of the best results, and by consulting the following table one may learn what ration was fed the several animals of our herd each month in the year, and by comparing with other tables presented in this report the effect of such feed, as also of the changes from one kind of feed to another, may be determined, and the knowledge thus obtained is sure to be of interest and may be of great value by way of suggesting certain experiments indicated by the results here recorded. As is well known to the practical feeder, very marked differences are found to result from simply a change of feed without regard to the difference in composition of such feed, and the following pages will record many such changes made with our herd and the results presumably produced thereby :

FOOD FED COWS DURING EXPERIMENTS.

	NAME.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds grain, mixed.
1890						
February	Miss Flow 5th	183.6	....	....	38.0	82.5
March	Miss Flow 5th	326.0	230.0	....	7.3	186.0
April	Miss Flow 5th	378.9	....	....	463.1	180.0
April	Countess Flavia	97.1	....	....	176.0	25.3
May	Miss Flow 5th	355.0	633.0	....	....	246.6
May	Countess Flavia	297.5	569.2	....	....	187.5
June	Miss Flow 5th	506.4	660.0	....	....	295.4
June	Countess Flavia	450.6	555.6	....	....	270.0
July	Esel 2d	36.0	....	344.0	....	48.0
July	Miss Flow 5th	136.0	....	832.2	....	273.5
July	Queen Duchess	22.0	....	124.7	....	18.5
July	Countess Flavia	347.4	....	439.5	....	278.9
August	Esel 2d	139.5	636.3	619.8	....	253.2
August	Miss Flow 5th	146.4	504.7	567.2	....	274.6
August	Queen Duchess	119.6	472.4	485.1	....	193.0
August	Countess Flavia	148.6	467.4	470.3	....	279.0
August	Barbara Allen	12.0	90.0	....	....	6.0
September	Esel 2d	147.2	1073.5	200.0	....	265.5
September	Miss Flow 5th	143.7	799.9	160.0	....	218.7
September	Queen Duchess	119.2	800.0	160.0	....	172.9
September	Countess Flavia	144.6	783.6	160.0	....	245.5
September	Barbara Allen	119.8	700.7	150.0	....	129.0
September	Gilderbloom	77.3	468.1	149.6	....	72.0
September	Nellie 6th	34.7	205.4	121.5	....	35.0

September ..	Maggie 6th	20.5	10.4	128.1	....	....
October.....	Esel 2d	307.5	....	499.2	219.9	279.0
October	Miss Flow 5th	272.2	....	399.5	198.0	217.0
October	Queen Duchess	275.0	....	400.0	198.0	217.0
October	Countess Flavia	243.9	....	398.0	198.0	248.0
October	Barbara Allen	243.8	....	353.9	198.0	207.1
October	Gilderbloom	233.3	....	364.1	198.0	217.0
October	Nellie 6th	191.3	....	282.9	196 4	177.0
October	Maggie 6th	214.8	....	190.9	198.0	170.0
November ..	Esel 2d	367.5	....	....	600.0	270.0
November ..	Miss Flow 5th	339.0	....	....	538.2	210.0
November ..	Queen Duchess	338.1	....	....	540.0	210.0
November ..	Countess Flavia	308.7	....	....	540.0	240.0
November ..	Barbara Allen	308.9	....	....	540.0	210.0
November ..	Gilderbloom	275.0	....	....	540.0	210.0
November ..	Nellie 6th	270.6	....	....	540.0	189.3
November ..	Maggie 6th	264.6	....	....	540.0	206.8
November ..	Rosette Ford	144.5	....	....	225.0	18.5
December...	Esel 2d	386.0	520.7	....	....	279.0
December...	Miss Flow 5th	352.9	516.5	....	....	217.0
December...	Queen Duchess	367.9	515.9	....	....	217.0
December...	Manton Belle	259.8	346.7	....	....	....
December...	Countess Flavia	319.0	467.2	....	....	248.0
December...	Barbara Allen	325.0	467.0	....	....	217.0
December...	Gilderbloom	278.3	459.8	....	....	217.0
December...	Nellie 6th	221.9	455.9	....	....	174.5
December...	Maggie 6th	244.6	430.0	....	....	217.0
December...	Rosette Ford	266.1	434.7	....	....	166.5
December...	Oriole	200.9	347.0	....	....	14.5

FOOD FED COWS DURING EXPERIMENTS — (*Continued*).

	NAME.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds grain, mixed.
1891						
January	Esel 2d	247.3	929.7	....	....	279.0
January	Miss Flow 5th	230.7	862.5	....	....	34.0
January	Queen Duchess	243.8	930.0	....	....	248.0
January	Manton Belle	246.6	930.0	....	....	66.5
January	Countess Flavia	217.1	926.6	....	....	248.0
January	Barbara Allen	216.9	868.0	....	....	217.0
January	Gilderbloom	184.2	868.0	....	....	217.0
January	Nellie 6th	142.8	743.9	....	....	186.0
January	Maggie 6th	154.1	744.0	....	....	186.0
January	Rosette Ford	177.0	867.2	....	....	217.0
January	Oriole	186.0	731.3	....	....	53.0
February ...	Esel 2d	223.9	839.1	....	....	250.0
February ...	Queen Duchess	223.3	839.9	....	....	224.0
February ...	Manton Belle	223.6	839.9	....	....	172.5
February ...	Junietta Peerless	104.0	311.8	....	....	12.5
February ...	Countess Flavia	168.8	776.7	....	....	224.0
February ...	Barbara Allen	194.9	783.8	....	....	196.0
February ...	Gilderbloom	244.7	784.0	....	....	196.0
February ...	Nellie 6th	123.0	665.4	....	....	168.0
February ...	Maggie 6th	139.2	671.5	....	....	168.0
February ...	Rosette Ford	167.4	783.7	....	....	196.0
February ...	Oriole	168.0	710.0	....	....	145.0
March	Esel 2d	247.9	929.7	....	....	279.0
March	Queen Duchess	248.0	929.9	....	....	248.0
March	Manton Belle	248.0	930.0	....	....	217.0

March	Junietta Peerless	186.0	744.0	....	....	68.5
March	Countess Flavia	216.1	860.1	....	....	248.0
March	Barbara Allen	216.9	867.8	....	....	217.0
March	Gilderbloom	181.0	847.6	....	....	208.9
March	Nellie 6th	98.9	620.7	....	....	186.0
March	Maggie 6th	155.0	743.8	....	....	186.0
March	Rosette Ford	185.9	868.0	....	....	217.0
March	Oriole	185.9	841.0	....	....	210.5
March	Ione	116.7	471.9	....	....	27.0
April	Esel 2d	389.4	449.6	....	....	270.0
April	Queen Duchess	388.3	450.0	....	....	240.0
April	Manton Belle	390.0	450.0	....	....	210.0
April	Junietta Peerless	298.4	360.0	....	....	137.5
April	Countess Flavia	323.9	418.6	....	....	215.0
April	Barbara Allen	298.9	419.5	....	....	210.0
April	Gilderbloom	274.8	365.1	....	....	162.0
April	Nellie 6th	208.7	263.5	....	....	180.0
April	Maggie 6th	239.2	359.2	....	....	180.0
April	Rosette Ford	399.9	420.0	....	....	210.0
April	Oriole	300.0	420.0	....	....	210.0
April	Ione	291.4	358.0	....	....	120.0
May	Esel 2d	248 0	829.6	....	....	279.0
May	Queen Duchess	248.0	930.0	....	....	248.0
May	Manton Belle	226.0	863.3	....	....	205.5
May	Junietta Peerless	186.0	744.0	....	....	185.0
May	Countess Flavia	185.9	866.8	....	....	185.0
May	Barbara Allen	181.9	830.3	....	....	193.5
May	Gilderbloom	154.5	744.0	....	....	183.0
May	Nellie 6th	121.0	525.7	....	....	186.0
May	Maggie 6th	147.3	743.4	....	....	186.0
May	Rosette Ford	185.9	868.0	....	....	217.0
May	Oriole	182.2	867.9	....	....	213.5

FOOD FED COWS DURING EXPERIMENTS — (*Continued*).

1891	NAME.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds grain, mixed.
May	Ione	184.8	715.6	....	....	181.0
May	Genevie's Gift	59.9	276.0	....	....	8.0
June	Esel 2d	240.0	213.0	721.8	....	270.0
June	Queen Duchess	240.0	213.0	720.6	....	240.0
June	Manton Belle	240.0	198.0	716.3	....	189.5
June	Junietta Peerless	180.0	168.0	665.5	....	180.0
June	Countess Flavia	180.0	196.7	636.3	....	180.0
June	Barbara Allen	180.0	198.0	647.3	....	210.0
June	Gilderbloom	150.0	168.0	624.1	....	180.0
June	Nellie 6th	116.9	116.9	491.1	....	.3
June	Maggie 6th	150.0	168.0	555.1	....	180.0
June	Rosette Ford	180.0	198.0	642.3	....	210.0
June	Oriole	178.3	198.0	641.2	....	210.0
June	Ione	179.6	156.2	628.6	....	180.0
June	Genevie's Gift	149.8	167.8	589.0	....	72.5
July	Esel 2d	120.0	502.0	745.3	....	279.0
July	Queen Duchess	120.0	501.9	745.6	....	248.0
July	Manton Belle	120.0	502.0	744.9	....	209.5
July	Junietta Peerless	90.0	406.0	699.9	....	186.0
July	Countess Flavia	90.0	468.6	654.1	....	186.0
July	Barbara Allen	90.0	470.0	667.5	....	217.0
July	Gilderbloom	75.0	470.0	666.0	....	186.0
July	Nellie 6th	55.6	305.0	522.7	....	112.0
July	Maggie 6th	75.0	406.0	577.9	....	186.0
July	Rosette Ford	90.0	470.0	668.7	....	217.0

July	Oriole	90.0	470.0	667.9	....	217.0
July	Ione	90.0	467.5	664.5	....	186.0
July	Genevie's Gift	74.8	405.8	605.0	....	119.5
August	Esel 2d	....	979.9	554.0	....	279.0
August	Queen Duchess	....	928.0	536.2	....	248.0
August	Manton Belle	....	928.0	534.9	....	217.0
August	Junietta Peerless	....	812.0	504.8	....	186.0
August	Countess Flavia	....	869.7	490.5	....	186.0
August	Barbara Allen	....	870.0	502.4	....	217.0
August	Gilderbloom	....	870.0	499.7	....	186.0
August	Nellie 6th	....	541.3	363.3	....	124.0
August	Maggie 6th	....	751.4	435.6	....	186.0
August	Rosette Ford	....	870.0	501.2	....	217.0
August	Oriole	....	870.0	503.8	....	217.0
August	Ione	....	854.3	501.2	....	186.0
August	Genevie's Gift	....	754.0	432.1	....	124.0
September	Esel 2d	238.5	....	1,044.4	....	270.0
September	Queen Duchess	239.0	....	956.8	....	206.5
September	Manton Belle	239.2	....	959.9	....	210.0
September	Junietta Peerless	179.7	....	813.1	....	180.0
September	Countess Flavia	176.5	....	799.1	....	137.0
September	Barbara Allen	178.2	....	878.6	....	210.0
September	Gilderbloom	145.7	....	824.9	....	180.0
September	Nellie 6th	102.1	....	574.9	....	120.0
September	Maggie 6th	148.8	....	769.2	....	176.7
September	Rosette Ford	179.9	....	889.9	....	210.0
September	Oriole	179.5	....	862.7	....	214.5
September	Ione	170.7	....	926.6	....	180.0
September	Genevie's Gift	144.5	....	765.4	....	119.9
October	Esel 2d	421.5	....	627.0	....	279.0
October	Queen Duchess	450.0	....	406.0	47.0	29.0
October	Manton Belle	422.4	....	560.0	....	191.5

FOOD FED COWS DURING EXPERIMENTS — (*Concluded*).

	NAME.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds grain, mixed.
October	Junietta Peerless	307.0	....	467.0	....	186.0
October ...	Countess Flavia	400.2	....	297.0	42.7	10.0
October	Barbara Allen	315.3	....	546.6	....	210.0
October	Gilderbloom	250.2	....	463.5	....	186.0
October	Maggie 6th	263.8	....	466.0	....	186.0
October	Rosette Ford	316.7	....	546.6	....	217.0
October	Oriole	317.7	....	546.6	....	232 5
October	Ione	310.8	....	559.0	....	186.0
October	Genevie's Gift	258.7	....	466.8	....	124.0
November...	Esel 2d	359.4	723.8	....	....	270.0
November...	Queen Duchess	38.0	....	....	94.0	....
November...	Junietta Peerless	270.0	539.0	....	....	180.0
November...	Manton Belle	360.0	624.9	....	84.0	150.5
November...	Barbara Allen	270.0	599.0	....	....	210 0
November...	Gilderbloom	205.3	538.9	....	....	165.0
November...	Maggie, 6th	223.0	599.5	....	....	180.0
November...	Rosette Ford	269.9	591.2	....	....	210.0
November...	Oriole	269.7	629.0	....	....	225.0
November...	Ione	264.3	645.9	....	....	180.0
November...	Genevie's Gift	216.6	511.0	....	....	120.0
December...	Esel 2d	244.7	1078.8	....	....	279.0
December...	Junietta Peerless	186.0	744.0	....	....	186.0
December...	Manton Belle	168.0	504.0	....	....	26.0

December ..	Gilderbloom	150.4	743.9	....	....	170.5
December ..	Barbara Allen	185.9	840.0	....	....	217.0
December ..	Maggie 6th	155.0	681.9	....	....	186.0
December ..	Rosette Ford	162 5	754.6	....	....	153.5
December ..	Oriole	184.3	868.0	....	....	232.5
December ..	Ione	177.5	816.8	....	....	186.0
December ..	Genevie's Gift	150.1	681.0	....	....	124.0

PROXIMATE CONSTITUENTS OF THE DRY MATTER IN FOODS FED COWS DURING EXPERIMENT.

Analysis of Cattle Foods, 1890–1891.

FOODS.	Time fed.	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free extract.	Fat.	Invert sugar.	Sucrose.	Starch.	Albuminoid nitrogen.	Amide nitrogen.	Pure fat in dry matter.
Oat hay	February 6 to 17	13.90	6.87	7.00	36.83	46.15	3.14	0.94	0.64	27.84	1.04	0.08	1.96
Mixed hay	February 18 to May 31	11.06	6.65	12.13	33.31	44.68	3.63	4.96	1.28	24.40	1.07	0.87	2.18
Beet roots	February 6 to March 2	85.92	9.66	8.52	8.73	72.52	0.57	6.30	40.92	4.37	0.74	0.69	0.32
Mixed grain, No. 6	February 6 to September 30	10.61	5.22	23.28	9.78	56.38	5.34	0 61	1.31	36.18	3.02	0.31	4.92
Corn ensilage	March 3 to 30	69.22	3.12	8.18	19.68	63.37	5.65	......	1.36	38.04	0.79	0.52	3.39
Mixed roots	April 1 to 30	87.53	7.38	9.54	7.06	74.50	1.52	10.72	39.28	5.36	0.84	0.69	0.86
Corn ensilage	May 1 to June 30	73.26	4.41	11.22	21.24	58.65	4.48	0.60	0.92	36.06	0.83	0.97	2.69
Kentucky blue grass hay	June 1 to 26	13.53	7.61	9.56	33.50	44.65	4.68	2.78	1.28	17.08	1.26	0.27	2.81
Mixed hay	July 1 to September 30	11.06	6.65	12.13	33.31	44.68	3.63	4.96	1.28	24.40	1.07	0.87	2.18
Red clover forage	July 1 to 10	73.85	6.51	13.19	31.32	44.36	4.62	3.80	1.52	10.79	1.74	0.37	2.77
Oat and vetch forage	July 11 to 31	67.01	5 25	10.31	30.50	50.03	3.91	4.16	3.32	19.92	1.56	0.09	2.35
Oat and pea forage	August 1 to 16	74 53	5.80	17.19	23.90	48.60	4.51	4.72	2.72	18.60	1.82	0.93	2.71
Corn ensilage	August 17 to September 25	80.45	5,14	11.69	23.96	55.01	4.20	0.44	0.08	32.68	0.68	1.19	2.52
Sorghum forage	September 26 to October 10	77.11	4.90	12.94	22.94	54.32	4.90	18.96	14.32	21.17	1.38	0.69	2.94
Corn forage	October 11 to 20	81.29	5.98	10.12	25.67	53.52	4.71	10.64	2.80	17.48	1.16	0.46	2.83
Beet roots	October 21 to November 30	88.98	8.68	13.56	7.16	69.36	1.24	6.04	44.52	00.00	1.95	0.22	0.71
Clover hay	October 1 to November 30	14.46	6.29	10.44	33.95	44.69	4.63	4.06	2.32	9.88	1.36	0.31	2.67
Mixed grain, No. 11	October 1 to November 30	12.83	3.58	17 19	8.89	65.06	5.28	1.04	1.92	57.90	2.03	0.72	4.86
Mixed hay	December 1, to February 15	11.40	7.48	11.75	35.13	40.08	5.56	2.48	0.80	16.30	1.26	0.62	3.34
Clover ensilage	December 1 to 30	77.23	7.70	14.56	29 11	41.07	7.56	1.64	0.00	10.80	1.68	0.65	4.52
Mixed grain, No. 13	December 1 to January 31, 1891	13.58	3.50	13.69	7.43	71.87	3.51	1.00	2.00	54.36	2.16	0.03	3.22
Corn ensilage	January 1 to February 16	80.16	4.60	13.19	23.93	51.60	6.68	1.28	0.60	29.92	1.11	1.00	4.00
Clover and Timothy hay	February 16 to May 30	15.76	6.63	13.25	35.08	39.97	5.07	3.52	1.68	11.58	1.79	0.32	3.04
Beet roots	February 16 to 28	88.98	8.68	13.56	7.16	69.36	1.24	6.04	44.52	0.00	1.95	0.22	0.70
Corn ensilage	March 1 to June 15	80.16	4.60	13.19	23.93	51.60	6.68	1.28	0.60	29.92	1.11	1.00	4.00
Mixed grain, No. 14	March 1 to 30	14.97	5.36	22.06	9.86	51.40	5.32	0.90	3.00	49.59	2.88	0.65	4.86
Mixed grain, No. 16	April 1 to May 31	13.50	5.04	19.12	9.14	61.01	5.69	1.75	2.87	57.71	2.85	0.21	5.18
Mixed hay	June 1 to 30	10.08	6.51	11.38	35.80	40.20	6.11	4.04	1.97	18.85	1.55	0.27	3.67
Alfalfa forage	June 1 to 30	71.86	8.54	23.50	25.83	36.23	5.90	4.24	3.76	12.71	1.91	1.85	3.54
Mixed grain. No. 17	June 1 to July 31	11.50	3.48	16.25	5.29	68.72	6.26	1.20	1.71	51.72	2.60	0.00	5.72
Mixed hay	July 1 to 15	11.39	5.74	17.62	33.23	38.58	4.83	4.56	1.44	15.48	1.52	1 30	2.90
Corn ensilage	July 16 to August 29	80.16	4.60	13.19	23.93	51.60	6.68	1.28	0.60	29.92	1.11	1.00	4.01
Oat and pea forage	July 1 to 15	77.75	8.26	15.87	30.46	39.90	5.51	4.40	0.00	19.40	1.66	0.88	3.31
Alfalfa forage	July 16 to August 15	71.86	8.54	23.50	25.83	36.23	5.90	4.24	3.76	12.71	1.91	1.85	3.54

Timothy rowen forage..	August 16 to August 31	74.65	9.97	9.63	28.67	46.58	5.15	1.13	0.22	23.31	1.29	0.25	3.09
Mixed grain, No. 19......	August 1 to September 30........	9.88	5.15	20.00	7.35	61.84	5.66	1.04	2.57	45.68	2.82	0.38	5.15
Mixed hay................	September 1 to November 30.....	13.15	5.27	10.44	28.38	53.22	2.69	1.05	0.26	19.66	1.55	0.12	1.61
Barley and pea forage ..	September 1 to 15	74.12	7.25	16.31	26.13	46.57	3.74	1.13	0.64	21.78	2.05	0.56	2.24
Alfalfa forage...........	September 16 to 30...............	74.53	11.16	20.36	25.39	39.59	3.48	0.65	0.09	11.90	2.68	0.58	2.09
Corn forage	October 1 to 20...................	69.88	3.19	7.00	19.59	67.01	3.21	0.56	5.53	30.91	1.09	0.04	1.93
Mixed grain, No. 21......	October 1 to November 30.......	11.69	4.49	18.00	9.19	63.35	4.97	0.00	2.56	54.56	2.68	0.20	4.52
Potatoes..................	October 28 to November 2........	76.81	4.13	10.94	1.90	82.78	0.25	0.00	1.82	59.05	0.81	0.94	0.15
Corn ensilage...........	November 1 to December 31.....	69.56	3.76	7.56	18.66	66.95	3.07	3.56	0.17	28.90	1.08	0.13	1.84
Beets.....................	November 3 to December 31.....	86.78	10.56	13.25	6.42	68.52	1.25	6.25	37.95	2.20	1.10	1.02	0.70
Wheat bran	November 27 to December 31....	12.78	5.72	16.81	8.05	66.13	3.29	0.40	6.22	44.70	2.64	0.05	2.96
Mixed hay................	December 1 to 31	12.90	6.30	11.06	34.52	45.21	2.91	0.38	0.58	19.30	3.70	0.07	1.75
Mixed grain, No. 23......	December 1 to January 31, 1892..	13.62	5.44	21.38	8.61	58.79	5.78	0.24	4.88	47.00	3.32	0.10	5.26
Ground oats	December 22 to 31	12.61	3.17	10.81	12.24	69.09	4.69	0.40	1.92	49.20	1.71	0.02	4.22

COMPOSITION BY WEIGHT OF GRAIN MIXTURES.

	Cotton-seed meal.	Corn meal.	Wheat bran.	Ground oats.	Linseed meal, old process.	Linseed meal, new process.	Wheat middlings.	Gluten meal.	Cost per ton.
Number 6	....	1	5	4	5	....	....	....	$23 50
Number 11	....	5	1	5	1	....	....	....	22 63
Number 13	....	5	2	4	1	....	....	....	22 21
Number 14	....	1	3	1	1	....	....	....	21 92
Number 16	....	3	6	....	2	....	....	....	21 18
Number 17	....	5	4	4	....	....	....	2	22 27
Number 19	....	5	5	....	....	3	2	....	21 30
Number 21	....	3	7	5	3	....	....	....	22 47
Number 23	2	....	6	5	2	....	....	....	23 67

The following tables give the amounts in pounds of each of the food constituents in the food consumed by each of the animals, as also the weight of each animal during each month of lactation:

ESEL 2D — HOLSTEIN-FRIESIAN.

Calved July 16, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
July	1,243	26.94	102.2	64.1	8.4	54.9	11 0
August	958	75.63	324.6	206.6	29.0	130.9	35.6
September	978	76.85	339.0	225.1	28.5	127.6	34.1
October	1,042	64.50	348.6	248.5	30.3	137.7	32.9
November	1,018	64.62	339.5	227.8	27.8	132.4	33.9
December	1,051	67.94	373.9	251.4	29.9	166.8	40.4
January	1,053	60.00	416.5	299.1	27.3	143.9	33.9
February	1,033	66.25	339.7	249.2	29.1	130.2	33.7
March	1,044	77.87	374.6	264.6	33.1	138.4	36.5
April	1,066	84.44	344.1	245.8	35.3	162.0	38.8
May	1,070	77.69	315.7	237.8	35.2	134.8	33.6
June	1,107	87.62	346.4	237.3	42.9	152.5	41.6
July	1,123	79.75	358.1	257.8	35.8	130.1	35.8
August	1,080	77.69	369.7	273.6	32.2	117.3	38.5
September	1,117	102.00	377.3	213.6	29.1	145.9	47.6
October	1,129	89.81	477.4	287.4	28.2	163.5	36.4
November	1,212	85.25	464.6	273.5	27.1	151.6	35.4
December	1,221	92.94	476.1	277.3	29.8	142.4	36.6

QUEEN DUCHESS — AYRSHIRE.

Calved July 24, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
July	904	8.62	40.4	26.1	3.3	21.9	4.6
August	778	57.50	253.0	161.1	22.5	104.1	28.0
September	760	46.25	238.3	163.1	20.5	96.3	24.9
October	765	53.31	287.9	200.7	25.1	118.2	27.9
November	741	55.06	289.6	188.5	23.8	118.7	29.9
December	755	59.43	327.9	222.4	27.3	157.1	37.3
January	756	56.19	395.9	282.8	26.5	141.0	32.8
February	756	62.19	326.9	237.5	27.9	127.9	32.5
March	756	73.25	359.5	182.1	31.7	135.8	35.2
April	783	79.69	328.0	229.5	33.7	159.3	37.4
May	804	74.31	309.6	227.4	35.1	137.1	33.1
June	826	82 62	328.1	222.7	41.2	151.0	40.7
July	837	75.25	339.3	249.9	34.1	128.6	34.9
August	835	71.37	342.2	252.5	29.8	110.8	36.0
September	903	88.81	332.2	180.9	25.1	136.0	42.8
October	922	56.50	315.8	150.1	15.7	137.2	25.7

JUNIETTA PEERLESS.— AYRSHIRE.

Calved February 4, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
February	911	13.20	69.4	50.9	7.2	37.3	12.6
March	743	37.60	219.6	82.1	19.0	94.7	21.5
April	746	54.20	229.7	152.5	23.7	119.4	26.9
May	783	56.25	236.4	173.0	26.9	104.9	25.2
June	807	66.25	259.6	174.8	33.1	122.7	33.6
July	853	60.75	272.1	193.3	27.8	108.0	29.3
August	834	57.62	286.2	209.4	25.0	97.5	31.0
September	892	74.06	274.3	152.0	21.0	110.2	35.3
October	881	63.06	340.2	201.6	19.9	118.3	25.9
November	934	62.62	335.3	193.3	19.3	111.8	25.7
December	925	64.44	333.1	191.5	20.6	101.9	25.7

MANTON BELLE — AYRSHIRE.

Calved December 11, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
December	1,123	21.25	122.0	73.4	12.8	90.6	16.8
January	976	35.12	284.3	193.6	21.0	130.2	27.4
February	886	54.44	301.7	214.0	25.6	123.7	30.2
March	896	68.50	344.4	167.9	30.3	133.2	33.7
April	916	75.31	312.7	213.6	32.3	157.4	36.2
May	938	64.81	272.9	197.2	31.1	124.0	29.4
June	929	75.06	295.4	197.1	38.2	147.6	38.8
July	973	69.75	315.8	224.2	32.0	126.8	33.7
August	956	66.31	324.8	238.7	28.2	108.7	35.5
September	1,013	89.50	334.5	182.6	25.3	136.5	43.0
October	1,053	75.56	415.3	235.9	23.7	152.7	32.3
November	1,116	65.56	377.9	203.5	20.9	136.4	29.6
December	1,126	39.12	264.5	128.2	12.4	93.3	23.2

MISS FLOW 5TH — AYRSHIRE.

Calved February 5, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
February	948	24.37	152.4	70.7	9.3	62.6	13.5
March	736	53.19	263.3	167.7	22.9	133.9	26.0
April	803	55.00	282.0	163.9	21.8	138.3	29.1
May	800	72.63	362.1	224.5	31.1	167.9	35.1
June	859	69.00	342.3	214.6	31.6	128.3	36.6
July	872	80.00	312.3	192.5	28.0	142.9	35.1
August	866	75.63	317.3	203.8	28.5	125.5	34.9
September	874	55.00	270.2	175.4	23.5	107.5	28.5
October	916	53.06	287.1	200.9	25.0	117.5	27.8
November	902	55.12	289.8	166.4	23.8	118.9	30.0
December	937	58.62	322.0	214.6	26.9	152.7	36.5
January	984	29.43	247.1	166.4	18.8	119.5	24.7

GILDERBLOOM — JERSEY.

Calved September 9, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
September	860	22.62	124.7	87.9	10.8	54.2	13.9
October	770	49.56	267.8	190.6	23.1	104.3	25.3
November	734	44.24	265.5	178.7	21.3	100.4	26.5
December	744	52.81	287.4	196.4	23.5	126.9	31.1
January	736	48.19	343.5	244.9	22.9	117.8	27.6
February	763	53.00	282.8	206.0	24.0	106.8	27.3
March	766	66.25	302.5	212.5	26.4	111.1	28.9
April	781	55.81	235.3	162.9	24.0	114.7	26.7
May	785	52.94	224.8	164.4	25.4	95.5	23.4
June	787	62.25	244.6	166.0	30.8	110.0	30.8
July	821	59.94	273.9	199.9	27.4	105.1	28.7
August	827	59.37	294.6	215.9	25.5	100.6	31.5
September	885	71.44	260.3	145.9	20.3	102.6	33.8
October	879	58.25	313.2	192.0	18.5	104.1	23.3
November	885	52.87	297.0	170.1	17.1	94.6	23.1
December	925	58.62	308.6	178.0	19.0	92.0	23.4

COUNTESS FLAVIA — JERSEY.

Calved April 19, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
April	788	12.10	61.5	39.3	4.7	32.4	8.0
May	695	50.63	299.3	185.9	25.6	141.2	28.9
June	696	68.13	206.6	191.8	28.5	76.3	23.1
July	693	75.00	288.3	181.1	26.0	126.5	32.3
August	673	73.13	304.3	197.0	27.4	118.9	33.5
September	700	60.00	282.0	193.8	24.6	109.4	29.8
October	724	54.37	294.2	212.6	25.3	111.2	27.1
November	712	56.25	295.4	200.3	24.0	112.5	29.3
December	714	59.06	323.4	223.1	25.9	141.4	34.5
January	736	54.56	384.9	275.2	25.6	132.7	31.2
February	750	57.69	285.8	217.4	25.3	108.8	28.5
March	756	69.00	336.7	238.8	29.7	123.9	32.7
April	771	69.37	288.2	203.8	29.4	146.5	32.4
May	789	57.94	249.0	180.7	28.5	110.7	26.3
June	789	65.69	259.6	174.9	33.0	122.0	33.1
July	800	60.81	277.7	198.3	27.8	108.6	29.2
August	801	59.19	293.6	215.3	25.4	99.9	31.3
September	849	66.12	247.8	132.4	18.6	105.7	32.6
October	838	46.69	259.3	80.2	18.5	117.0	21.6

BARBARA ALLEN — JERSEY.

Calved August 29, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
August	853	1.62	11.8	7.9	0.9	5.2	0.6
September	862	37.50	204.9	140.8	17.5	87.5	21.8
October	763	49.06	264.9	185.6	22.9	106.1	25.4
November	779	52.94	278.4	184.4	22.6	110.2	28.3
December	779	55.75	306.4	209.3	25.1	141.2	34.0
January	770	50.12	356.4	243.9	23.9	127.5	29.5
February	782	55.06	283.5	212.5	25.0	114.6	29.0
March	779	65.02	323.1	224.7	28.5	121.9	31.4
April	792	66.19	277.3	187.1	28.1	128.8	30.8
May	812	58.37	248.4	182.4	28.2	108.5	26.2
June	805	70.44	279.1	190.2	34.9	124.2	34.3
July	825	65.69	298.0	217.9	29.7	111.1	30.5
August	795	64.37	312.2	229.9	27.2	102.8	33.0
September	871	81.25	297.4	167.7	23.1	116.1	38.3
October	861	69.00	373.5	224.3	21.9	127.0	28.0
November	913	66.25	364.3	214.5	21.2	117.6	27.5
December	913	71.94	368.5	215.0	23.1	109.7	28.3

NELLIE 6TH — AMERICAN HOLDERNESS.

Calved September 13, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
September	918	12.94	75.9	54.8	6.4	30.5	6.9
October	756	40.75	220.0	156.9	18.8	85.0	21.0
November	757	47.87	252.1	168.1	20.2	97.5	25.6
December	765	44.44	238.4	159.8	20.3	107.2	26.4
January	756	40.44	288.5	205.9	19.1	96.5	21.8
February	770	43.87	233.6	171.4	19.8	80.7	22.3
March	769	45.87	225.3	164.6	19.6	75.7	20.9
April	765	57.25	206.6	153.0	20.9	90.9	22.6
May	783	47.31	192.7	150.5	21.3	75.4	19.6
June	785	28.31	104.3	59.9	16.1	78.9	19.7
July	775	40.69	183.2	129.4	18.8	76.1	20.5
August	793	39.69	193.7	141.2	17.1	66.9	21.3
September	855	49.37	177.7	98.7	13.8	71.1	23.8
October	873	34.81	202.5	111.6	11.2	75.5	15.4

MAGGIE 6TH — AMERICAN HOLDERNESS.

Calved September 25, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
September	912	4.81	25.6	22.6	2.2	14.2	2.7
October	777	41.93	226.3	157.3	19.5	91.7	22.0
November	726	49.37	259.7	176.6	20.7	97.1	25.9
December	745	55.31	291.8	192.6	25.7	129.4	32.4
January	730	41.06	292.9	208.9	19.5	99.9	23.4
February	721	45.19	240.8	175.7	20.5	90.5	23.3
March	733	52.75	265.6	187.0	23.2	96.7	25.3
April	757	55.19	231.9	167.0	23.3	105.3	25.4
May	763	52.75	223.9	168.0	25.2	93.5	23.1
June	800	59.94	237.6	162.0	29.6	105.0	29.2
July	796	56.37	255.7	183.9	25.5	95.1	26.2
August	805	55.44	269.0	198.0	23.4	88.8	28.5
September	855	69.25	253.2	142.6	19.7	99.4	32.8
October	850	59.44	319.9	193.8	18.8	107.5	23.9
November	891	55.81	305.5	180.8	17.8	98.0	23.0
December	907	67.81	306.1	185.9	19.3	90.8	23.6

ROSETTE FORD — GUERNSEY.

Calved November 14, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
November	999	15.56	82.9	42.4	6.9	45.1	10.4
December	851	46.19	248.8	167.4	21.1	118.3	2.84
January	841	45.00	309.2	222.6	20.2	104.3	27.2
February	849	55.00	282.9	188.7	24.0	107.1	27.5
March	842	61.94	311.5	150.6	27.2	114.1	29.8
April	852	75.81	311.4	212.0	32.4	158.6	36.4
May	862	62.81	266.0	198.0	30.1	113.3	27.7
June	873	70.25	278.6	189.9	34.8	123.9	34.2
July	885	65.69	298.2	214.2	29.8	111.1	30.5
August	876	64.37	312.0	229.8	27.1	102.7	33.0
September	923	81.81	299.4	168.7	23.2	117.2	38.6
October	899	70.12	378.0	228.0	22.2	127.9	28.4
November	950	66.06	362.7	213.8	21.1	117.2	27.4
December	943	56.81	307.7	173.6	18.5	94.3	23.2

ORIOLE — GUERNSEY.

Calved December 7, 1890.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
December	867	20.12	112.6	68.7	11.6	77.7	15.0
January	686	27.25	220.9	149.5	16.3	90.0	21.1
February	627	44.41	246.7	158.2	21.0	98.7	24.4
March	624	60.62	304.1	147.7	26.6	112.1	29.2
April	649	66.37	277.7	197.8	28.1	129.1	30.8
May	668	61.94	262.9	195.6	29.7	111.9	27.4
June	692	70.00	277.9	189.5	34.7	123.2	34.1
July	697	65.69	298.1	214.2	29.7	111.1	30.5
August	682	64.44	312.3	229.9	27.2	102.9	33.1
September	737	81.50	298.6	169.1	23.2	115.6	38.2
October	739	72.50	387.1	236.0	22.9	129.4	29.0
November	788	69.06	378.7	235.0	22.1	120.5	28.4
December	777	75.06	381.4	224.4	24.1	112.0	29.3

Ione — Devon.

Calved March 7, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
March	842	18.94	99.1	58.9	9.7	52.9	11.6
April	713	48.44	189.9	124.2	20.5	105.9	23.6
May	722	55.06	231.0	168.9	26.2	102.9	24.7
June	741	64.81	254.5	171.9	32.3	119.3	32.6
July	758	63.00	278.5	198.7	27.9	109.2	29.4
August	779	59.12	292.3	214.2	25.4	99.7	31.4
September	841	77.31	281.2	154.5	21.7	114.7	37.5
October	850	65.31	360.5	212.7	20.9	124.7	27.0
November	892	62.31	354.4	202.9	20.1	116.5	26.6
December	909	65.25	344.0	197.2	21.1	104.0	26 2

GENEVIE'S GIFT — DEVON.

Calved May 15, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
May	660	10.69	52.6	30.2	6.6	31.4	6.0
June	550	45.62	175.5	111.9	24.2	102.4	26.6
July	560	45.37	217.6	153.1	22.1	93.8	24.6
August	561	45.50	234.5	170.6	20.2	84.6	25.6
September	611	59.87	218.9	116.2	16.6	94.3	29.9
October	624	49.81	283.1	161.7	16.0	101.4	21.2
November	672	46.56	271.4	150.7	15.1	92.1	20.5
December	675	49.00	271.8	150.8	16.1	84.9	20.5

The following tables give the milk yield in pounds and its percentage composition, as also the pounds of each constituent present in the milk, for each cow and for each month of lactation:

ESEL 2D — HOLSTEIN FRIESIAN.

Calved July 16, 1890.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
July........	273.0	13.47	4.86	2.91	5.06	0.64	36.7	13.3	7.9	13.8	1.7
August.....	884.0	12.32	3.64	2.88	5.12	0.68	108.9	32.2	25.5	45.3	6.0
September...	895.0	12.26	3.86	2.83	4.89	0.68	109.7	34.5	25.3	43.8	6.1
October....	780.6	12.36	3.64	3.05	4.96	0.71	97.5	28.4	23.8	38.7	5.5
November...	750.5	12.62	3.66	3.17	5.31	0.48	94.7	27.5	23.8	39.8	3.6
December...	725.1	12.92	3.92	3.58	4.66	0.76	93.7	28.4	26.0	33.8	5.5
January....	790.1	13.12	3.55	2.94	5.85	0.78	103.7	28.0	23.2	46.2	6.2
February...	655.8	13.32	3.73	2.93	5.93	0.73	87.3	24.5	19.2	38.9	4.8
March......	638.1	13.81	3.91	3.67	5.49	0.74	88.1	24.9	23.4	35.0	4.7
April.......	544.7	14.33	3.95	4.01	5.52	0.85	78.1	21.5	21.8	30.1	4.6
May........	560.6	13.60	3.72	3.98	5.22	0.68	76.2	20.8	22.3	29.3	3.8
June........	683.0	13.26	3.20	3.74	5.55	0.77	90.6	21.9	25.5	37.9	5.3
July........	741.6	12.40	2.99	3.86	4.86	0.69	91.9	22.2	28.6	36.0	5.1
August.....	662.0	12.35	2.92	3.68	5.00	0.75	81.8	19.3	24.4	33.1	5.0
September...	612.9	12.64	3.87	4.29	3.75	0.73	77.5	23.7	26.3	23.0	4.5
October.....	617.2	12.89	3.30	4.22	4.59	0.78	79.5	20.4	26.0	28.3	4.8
November...	563.8	12.96	3.11	3.92	5.11	0.82	73.0	17.5	22.1	28.8	4.6
December...	540.3	12.67	2.80	3.39	5.72	0.76	68.4	15.1	18.3	30.9	4.1

QUEEN DUCHESS — AYRSHIRE.

Calved July 24, 1890.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
July	99.7	13.51	3.96	3.60	5.19	0.76	13.5	3.9	3.6	5.2	0.8
August	805.7	13.55	4.35	3.13	5.35	0.72	109.2	35.0	25.2	43.1	5.8
September ..	671.1	13.31	4.48	2.91	5.25	0.67	89.3	30.1	19.5	35.2	4.5
October.....	701.6	12.77	3.91	3.06	5.07	0.73	89.6	27.4	21.5	35.6	5.1
November...	657.8	12.97	3.95	3.54	4.92	0.56	85.3	26.0	23.3	32.4	3.7
December...	703.9	13.47	3.78	3.38	5.59	0.72	94.8	26.6	23.8	39.3	5.1
January	747.1	13.45	3.60	2.95	6.10	0.80	100.5	26.9	22.0	45.6	6.0
February ...	649.0	13.29	3.31	3.08	6.16	0.74	86.2	21.5	20.0	40.0	4.8
March	702.2	13.42	3.86	3.55	5.36	0.65	94.2	27.1	24.9	37.6	4.6
April	662.4	13.13	3.72	3.43	5.26	0.72	87.0	24.6	22.7	34.8	4.8
May	690.6	13.19	3.67	3.56	5.31	0.65	91.1	25.3	24.6	36.7	4.4
June	680.9	13.40	3.60	3.50	5.53	0.77	91.2	24.5	23.8	37.7	5.2
July........	673.5	13.30	3.72	3.76	5.09	0.73	89.6	25.1	25.3	34.3	4.9
August	558.0	14.28	4.13	3.79	5.57	0.79	79.7	23.0	21.2	31.1	4.4
September ..	363.3	14.46	3.95	4.47	5.26	0.78	52.5	14.4	16.2	19.1	2.8
October.....	122.4	16.34	5.30	5.63	4.79	0.62	20.0	6.5	6.9	5.9	0.7

JUNIETTA PEERLESS — AYRSHIRE.

Calved February 4, 1891.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
February ...	193.5	12.82	3.05	3.32	5.81	0.64	24.8	5.9	6.4	11.2	1.2
March	453.5	12.14	2.97	3.13	5.36	0.68	55.0	13.5	14.2	24.3	3.1
April	462.6	12.09	2.94	2.87	5.56	0.72	55.9	13.6	13.3	25.7	3.3
May	512.4	12.16	2.86	3.55	5.07	0.68	62.3	14.6	18.2	26.0	3.5
June	487.0	11.99	2.78	3.12	5.42	0.67	58.4	13.5	15.2	26.4	3.3
July	488.9	12.14	2.72	3.51	5.21	0.70	59.4	13.3	17.2	25.5	3.4
August	486.1	12.34	2.91	3.32	5.46	0.65	59.9	14.1	16.1	26.5	3.2
September ..	427.1	12.49	3.12	3.29	5.26	0.82	53.3	13.3	14.0	22.5	3.5
October	435.8	12.72	3.09	4.04	4.88	0.71	55.4	13.5	17.6	21.2	3.1
November ...	410.1	12.86	2.91	3.44	5.78	0.73	52 7	11.9	14.1	23.7	3.0
December ...	434.9	13.16	2.93	2.99	6.59	0.65	57.2	12.7	13.0	28.7	2.8

MANTON BELLE — ARYSHIRE.

Calved December 11, 1890.

MONTH.	Milk yield. pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
December...	327.8	13.32	4.00	3.42	5.17	0.73	43.7	13.1	11.2	16.9	2.4
January	649.6	11.58	3.10	2.41	5.38	0.69	75.2	20.1	15.6	34.9	4.5
February....	655.4	11.80	2.82	3.01	5.28	0.69	77.3	18.5	19.7	34.6	4.5
March	714.2	12.60	3.63	3.13	5.33	0.51	90.0	25.9	22.3	38.1	3.6
April	688.8	12.59	3.40	3.03	5.51	0.65	86.7	23.4	20.9	37.9	4.5
May	664.5	12.39	3.28	3.10	5.41	0.60	82.3	21.8	20.6	35.9	4.0
June	652.1	11.82	3.36	3.07	4.77	0.62	77.0	21.9	20.0	31.1	4.0
July	657.3	12.12	3.22	3.27	5.00	0.63	79.7	21.2	21.5	32.9	4.1
August	588.7	12.49	3.42	3.29	5.16	0.62	73.5	20.1	19.4	30.4	3.6
September ..	464.7	13.07	3.75	3.68	4.96	0.68	60.7	17.4	17.1	23.0	3.2
October	385.0	13.58	3.83	4.29	4.80	0.66	52.3	14.7	16.5	18.5	2.5
November...	271.1	14.21	3.52	3.62	6.34	0.73	38.5	9.5	9.8	17.2	2.0
December...	76.6	14.44	3.67	4.21	5.74	0.82	11.2	2.8	3.3	4.5	0.6

MISS FLOW 5TH — AYRSHIRE.

Calved February 5, 1890.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
February ...	363.5	14.85	5.60	3.15	5.45	0.65	54.0	20.3	11.4	19.8	2.4
March......	626.1	13.06	3.96	3.23	5.19	0.68	81.8	24.8	20.2	32.5	4.3
April.......	573.6	13.13	3.91	3.15	5.36	0.71	75.3	22.4	18.1	30.7	4.1
May........	588.0	13.18	4.00	3.66	4.92	0.60	77.5	23.5	21.5	28.9	3.5
June	591.6	13.23	3.80	4.08	4.64	0.71	78.3	22.5	24.1	27.4	4.2
July........	534.4	13.12	4.11	3.71	4.64	0.66	70.1	22.0	19.8	24.8	3.5
August	551.7	13.31	4.05	3.42	5.19	0.65	73.4	22.3	18.9	28.6	3.6
September ..	449.5	14.33	4.37	3.55	5.62	0.79	64.4	19.6	15.9	25.3	3.6
October.....	431.5	13.96	4.34	3.59	5.33	0.70	60.2	18.7	15.5	23.0	3.0
November...	333.9	14.98	4.95	4.00	5.45	0.58	50.0	16.5	13.4	18.2	1.9
December...	173.9	15.81	4.80	4.48	5.69	0.84	27.5	8.3	7.8	9.9	1.5
January.....	33.5	17.56	5.67	5.62	5.34	0.93	5.9	1.9	1.9	1.8	0.3

GILDERBLOOM — JERSEY.

Calved September 9, 1890.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
September . .	341.1	15.70	6.08	3.57	5.31	0.74	53.5	20.7	12.2	18.1	2.5
October	535.6	14.90	5.62	3.21	5.33	0.74	79.8	30.1	17.2	28.5	4.0
November . .	473.8	14.50	5.20	3.47	5.11	0.72	68.7	24.6	16.4	24.2	3.4
December . . .	410.7	15.56	6.16	3.47	5.15	0.78	63.9	25.3	14.2	21.1	3.2
January	428.4	15.51	5.47	3.43	5.80	0.81	66.4	23.3	14.4	25.2	3.5
February . . .	343.3	15.19	5.37	3.41	5.60	0.81	52.1	18.4	11.7	19.2	2.8
March	342.0	15.68	5.68	4.06	5.26	0.68	53.6	19.4	13.9	18.0	2.3
April	307.1	15.46	5.62	3.88	5.14	0.82	47.5	17.3	11.9	15.8	2.5
May	356.8	14.83	5.38	4.01	4.88	0.56	52.9	19.2	14.3	17.4	2.0
June	315.5	15.03	5.60	3.97	4.75	0.71	47.4	17.7	12.5	15.0	2.2
July	301.0	14.41	4.91	4.00	4.75	0.75	43.4	14.8	12.0	14.3	2.3
August	255.5	14.66	4.97	4.21	4.72	0.76	37.5	12.7	10.8	12.1	1.9
September . .	204.5	15.26	5.41	4.14	4.93	0.78	31.2	11.0	8 5	10.1	1.6
October	182.2	16.26	6.22	4.95	4.33	0.76	29.6	11.3	9.0	7.9	1.4
November . .	155.9	16.31	5.87	4.26	5.41	0.77	25.4	9.2	6.6	8.4	1.2
December . . .	164.3	15.96	6.45	4.24	4.45	0.82	26.2	10.6	7.0	7.3	1.3

COUNTESS FLAVIA — JERSEY.

Calved April 19, 1890.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
April	171.8	14.99	5.26	3.81	5.16	0.76	25.7	9.0	6.5	8.9	1.3
May	627.7	14.33	4.84	3.89	4.84	0.76	89.9	30.3	24.4	30.4	4.8
June	614.5	14.91	5.32	4.13	4.68	0.78	91.6	32.7	25.4	28.8	4.8
July........	580.5	14.90	5.36	3.78	5.02	0.74	86.5	31.1	21.9	29.1	4.3
August	574.0	14.81	5.37	3.70	5.00	0.74	85.0	30.8	21.2	28.7	4.2
September ..	492.4	16.15	6.12	4.04	5.26	0.73	79.5	30.1	19.9	25.9	3.6
October	474.1	15.89	6.00	3.84	5.26	0.79	75.3	28.4	18.2	24.9	3.7
November ..	442.7	16.41	6.41	3.99	5.19	0.82	72.6	28.4	17.6	23.0	3.6
December...	448.9	16.48	6.19	4.16	5.40	0.73	74.0	27.8	18.7	24.2	3.3
January	449.8	17.03	6.45	4.00	5.76	0.82	76.6	29.0	18.0	25.9	3.7
February ...	365.8	16.89	6.35	4.22	5.52	0.80	61.8	23.2	15.4	20.2	2.9
March	409.8	16.99	6.66	4.79	4.79	0.75	69.6	27.3	19.6	19.6	3.1
April	409.6	16.99	6.30	4.39	5.58	0.72	69.6	25.8	18.0	22.9	2.9
May	421.7	16.74	5.87	4.48	5.64	0.75	70.6	24.8	18.9	23.8	3.2
June	406.2	16.95	5.87	4.43	5.90	0.75	68.8	23.8	18.0	24.0	3.0
July........	408.1	16.42	5.89	4.08	5.68	0.77	67.0	24.0	16.7	23.2	3.1
August	377.9	16.84	6.32	4.37	5.46	0.69	63.6	23.9	16.5	20.6	2.6
September ..	261.9	18.95	8.07	4.44	5.55	0.89	49.6	21.1	11.6	14.6	2.3
October	87.0	17.94	6.30	5.66	5.11	0.87	15.6	5.5	4.9	4.4	0.8

BARBARA ALLEN — JERSEY.

Calved August 29, 1890.

MONTH.	Milk yield, pounds	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
September . .	519.0	14.03	4.92	3.14	5.27	0.70	72.8	25.5	16.3	27.3	3.6
October	501.7	14.23	5.05	3.28	5.21	0.69	71.4	25.3	16.5	26.1	3.5
November . .	494.2	14.26	5.33	3.55	4.66	0.72	70.5	26.3	17.5	23.0	3.6
December. . .	450.6	15.23	5.55	3.71	5.25	0.72	68.6	25.0	16.7	23.7	3.2
January	495.2	15.33	5.70	3.16	5.75	0.72	75.9	28.2	15.6	28.5	3.6
February . . .	409.9	15.37	5.48	3.72	5.38	0.79	63.0	22.5	15.2	22.0	3.2
March	437.4	15.29	5.39	4.18	4.99	0.73	66.9	23.6	18.3	21.8	3.2
April	418.1	14.91	5.46	4.00	4.75	0.70	62.3	22.8	16.7	19.9	2.9
May	432.8	15.14	5.34	4.01	5.01	0.78	65.5	23.1	17.4	21.7	3.4
June	468.3	14.84	4.89	3.80	5.46	0.69	69.5	22.9	17.8	25.6	3.2
July	471.7	14.63	5.15	3.94	4.82	0.72	69.0	24.3	18.6	22.7	3.4
August	444.0	14.80	5.52	3.94	4.66	0.68	65.7	24.5	17.5	20.7	3.0
September . .	337.1	15.47	5.58	3.90	5.24	0.75	52.1	18.8	13.1	17.7	2.5
October	367.4	15.92	5.41	4.81	4.92	0.78	58.5	19.9	17.7	18.1	2.8
November . .	340.7	16.21	6.16	4.10	5.23	0.72	55.2	21.0	14.0	17.8	2.4
December . .	361.9	16.59	6.27	4.24	5.37	0.71	60.0	22.7	15.3	19.4	2.6

Nellie 6th — American Holderness.

Calved September 13, 1890.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
September . .	240.3	13.78	4.78	3.51	5.06	0.43	33.1	11.5	8.4	12.2	1.0
October	513.9	12.10	3.54	2.82	5.08	0.66	62.2	18.2	14.5	26.1	3.4
November . . .	531.9	12.06	3.35	3.23	4.85	0.63	64.1	17.8	17.2	25.8	3.4
December . . .	455.4	12.30	3.25	3.06	5.32	0.67	56.0	14.8	13.9	24.2	3.1
January	474.6	12.40	3.30	2.85	5.52	0.73	58.8	15.7	13.5	26.2	3.5
February . . .	420.1	12.83	3.47	3.26	5.38	0.72	53.9	14.6	13.7	22.6	3.0
March	400.6	13.05	3.29	3.48	5.61	0.67	52.3	13.2	13.9	22.5	2.7
April	364.2	12.41	3.52	3.39	4.81	0.69	45.2	12.8	12.3	17.5	2.5
May	387.4	12.96	3.56	3.76	4.93	0.71	50.2	13.8	14.6	19.1	2.7
June	183.1	12.78	3.26	3.39	5.44	0.69	23.4	6.0	6.2	10.0	1.2
July	123.9	12.94	3.55	4.08	4.51	0.80	16.0	4.4	5.0	5.6	1.0

MAGGIE 6TH — AMERICAN HOLDERNESS.

Calved September 25, 1890.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
September ..	61.2	14.44	5.30	3.30	5.07	0.77	8.8	3.2	2.0	3.1	0.5
October	568.5	12.22	3.68	2.93	4.85	0.76	69.5	20.9	16.7	27.6	4.3
November ...	585.3	11.82	3.36	3.17	4.56	0.73	69.2	19.7	18.5	26.7	4.3
December ...	522.9	12.11	3.63	2.88	4.89	0.71	63.3	19.0	15.0	25.6	3.7
January	493.2	12.48	3.36	2.55	5.85	0.72	61.5	16.6	12.6	28.8	3.6
February ...	413.0	12.38	3.18	3.00	5.47	0.73	51.1	13.1	12.4	22.6	3.0
March	449.4	12.86	3.41	3.27	5.55	0.63	57.8	15.3	14.7	24.9	2.8
April	417.1	12.40	3.46	3.15	5.06	0.73	51.7	14.4	13.1	21.1	3.0
May	428.1	12.20	3.63	3.45	4.51	0.61	52.2	15.5	14.8	19.3	2.6
June	407.6	12.50	3.87	3.36	4.64	0.63	50.9	15.8	13.7	18.9	2.5
July	416.9	12.57	3.31	3.54	5.00	0.72	52.4	13.8	14.8	20.8	3.0
August	391.8	12.81	3.45	3.75	4.90	0.71	50.2	13.5	14.7	19.2	2.8
September ..	318.2	13.15	3.78	3.89	4.77	0 71	41.8	12.0	12.4	15.2	2.2
October	320.1	13.34	3.71	4.63	4.29	0.71	42.7	11.9	14.8	13.7	2.3
November ...	267.7	14.03	3.60	3.60	6.15	0.68	37.5	9.6	9.6	16.5	1.8
December ...	121.3	15.26	4.75	3.80	5.86	0.85	18.5	5.8	4.6	7.1	1.0

Rosette Ford — Guernsey.

Calved November 14, 1890.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
November ..	195.4	14.79	5.41	4.45	4.15	0.78	28.9	10.6	8.7	8.1	1.5
December...	543.4	14.63	5.30	3.20	5.41	0.72	79.5	28.8	17.4	29.4	3.9
January	561.5	14.04	4.74	3.09	5.49	0.72	78.8	26.6	17.3	30.8	4.0
February ...	482.3	14.20	4.90	3.48	5.10	0.72	68.5	23.6	16.8	24.6	3.5
March	501.9	14.60	5.12	3.57	5.17	0.74	73.3	25.7	17.9	25.9	3.7
April	478.8	14.66	5.03	3.42	5.46	0.75	70.2	24.1	16.4	26.1	3.6
May	515.9	14.47	4.81	3.85	5.02	0.79	74.6	24.8	19.9	25.9	4.1
June	476.1	14.54	4.76	3.79	5.32	0.67	69.2	22.7	18.0	25.3	3.2
July	463.7	14.27	4.74	3.80	4.99	0.74	66.2	22.0	17.6	23.1	3.4
August	452.0	14.95	4.98	3.99	5.25	0.73	67.6	22.5	18.0	23.7	3.3
September ..	380.4	14.93	5.71	3.56	4.93	0.73	56.8	21.7	13.5	18.8	2.8
October.....	386 9	16.40	5.93	4.49	5.14	0.84	63.4	22.9	17.4	19.9	3.2
November ..	347.3	16.34	6.20	4.61	4.78	0.75	56.7	21.5	16.0	16.6	2.6
December...	324.3	16.25	6.16	4.05	5.28	0.76	52.7	20.0	13.1	17.1	2.5

ORIOLE — GUERNSEY.

Calved December 7, 1890.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
December...	305.4	15.94	6.88	3.56	4.71	0.79	48.7	21.0	10.9	14.4	2.4
January	440.0	13.83	4.94	2.56	5.53	0.80	60.8	21.7	11.3	24.3	3.5
February ...	478.4	13.21	4.21	2.94	5.26	0.80	63.2	20.1	14.1	25.2	3.8
March.	536.3	13.75	4.45	3.64	4.92	0.74	73.7	23.9	19.5	26.4	4.0
April	557.3	14.07	4.90	3.45	4.97	0.75	78.4	27.3	19.2	27.7	4.2
May.	581.3	14.30	4.84	3.70	5.13	0.63	83.1	28.1	21.5	29.8	3.7
June	558.2	14.32	4.85	3.50	5.19	0.78	79.9	27.1	19.5	29.0	4.3
July.	577.9	14.18	4.95	3.70	4.81	0.72	81.9	28.6	21.4	27.8	4.1
August	560.6	14.89	5.22	3.87	4.99	0.81	83.5	29.3	21.7	28.0	4.5
September ..	475.3	15.11	5.30	4.48	4.56	0.77	71.8	25.2	21.3	21.7	3.6
October.....	521.8	15.85	5.65	4.58	4.88	0.74	82.7	29.5	23.9	25.5	3.8
November. ..	495.5	15.95	5.24	3.91	5.98	0.82	79.0	26.0	19.4	29.6	4.0
December...	538.4	16.23	5.21	4.52	5.69	0.81	87.4	28.1	24.3	30.6	4.4

IONE — DEVON.

Calved March 7, 1891.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
March	253.0	13.73	3.89	4.14	4.90	0.80	34.7	9.8	10.5	12.4	2.0
April	432.9	13.36	4.03	3.21	5.29	0.83	57.8	17.4	13.9	22.9	3.6
May	473.7	13.32	3.93	3.85	4.81	0.73	63.1	18.6	18.2	22.8	3.5
June	471.3	13.43	3.90	3.61	5.18	0.74	63.3	18.4	17.0	24.4	3.5
July........	460.4	13.65	3.93	3.85	5.08	0.79	62.8	18.1	17.7	23.4	3.6
August	392.4	14.44	4.54	3.96	5.17	0.77	56.7	17.8	15.6	20.3	3.0
September ..	323.5	14.62	4.67	3.95	5.14	0.86	47.3	15.1	12.8	16.6	2.8
October.....	346.0	14.84	4.45	4.54	5.05	0.80	51.3	15.4	15.7	17.5	2.7
November...	311.9	15.43	5.31	4.04	5.33	0.75	48.1	16.6	12.6	16.6	2.3
December...	328.8	15.32	4.66	3.73	6.23	0.70	50.4	15.3	12.3	20.5	2.3

GENEVIE'S GIFT — DEVON.

Calved May 15, 1891.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
May	158.8	12.41	3.25	3.86	4.72	0.58	19.7	5.2	6.1	7.5	0.9
June	403.7	12.66	3.38	3.33	5.21	0.74	51.1	13.7	13.4	21.0	3.0
July	383.1	13.27	4.00	3.45	5.11	0.71	50.8	15.3	13.2	19.6	2.7
August	326.3	14.03	4.69	3.65	4.96	0.73	45.8	15.3	11.9	16.2	2.4
September ..	265.2	14.44	4.95	3.56	5.06	0.87	38.3	13.1	9.5	13.4	2.3
October	277.9	15.69	5.09	4.63	5.22	0.75	43.6	14.1	12.9	14.5	2.1
November ..	243.2	16.70	6.31	3.88	5.73	0.78	40.6	15.4	9.4	13.9	1.9
December...	291.7	15.70	5.51	3.26	6.19	0.74	45.8	16.1	9.5	18.0	2.2

The following tables present the pounds of each constituent of the food consumed by each animal for each month of lactation, as also the average of each:

CRUDE FATS IN FOOD CONSUMED EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d	8.4	29.0	28.5	30.3	27.8	29.9	27.3	29.1	33.1	35.3	35.2	42.9	35.8	32.2	29.1	28.2	27.1	29.8	.....
Ayrshire........	Miss Flow 5th....	9.3	22.9	21.8	31.1	31.6	28.0	28.5	23.5	25.0	23.8	26.9	18.8	....	....	....	....	....	....	.....
Ayrshire........	Queen Duchess..	3.3	22.5	20.5	25.1	23.8	27.3	26.5	27.9	31.7	33.7	35.1	41.2	34.1	29.8	25.1	15.7	....	....	.....
Ayrshire........	Manton Belle	12.8	21.0	25.6	30.3	32.3	31.1	38.2	32.0	28.2	25.3	23.7	20.9	12.4	....	....	....	....	....	.....
Ayrshire........	Junietta Peerless	7.2	19.0	23.7	26.9	33.1	27.8	25.0	21.0	19.9	19.3	20.6	....	....	....	....	....	....	....	.....
Jersey	Gilderbloom	10.8	23.1	21.3	23.5	22.9	24.0	26.4	24.0	25.4	30.8	27.4	25.5	20.3	18.5	17.1	19.0	....	....	.....
Jersey	Countess Flavia.	4.7	25.6	28.5	26.0	27.4	24.6	25.3	24.0	25.9	25.6	25.3	29.7	29.4	28.5	33.0	27.8	25.4	18.6	18.5
Jersey	Barbara Allen ...	0.9	17.5	22.9	22.6	25.1	23.9	25.0	28.5	28.1	28.2	34.9	29.7	27.2	23.1	21.9	21.2	23.1	....	.....
Am. Holderness	Maggie 6th.......	2.2	19.5	20.7	25.7	19.5	20.5	23.2	23.3	25.2	29.6	25.5	23.4	19.7	18.8	17.8	19.3	....	....	.....
Am. Holderness	Nellie 6th.........	6 4	18.8	20.2	20.3	19.1	19.8	19.6	20.9	21.3	16.1	18.8	17.1	13.8	11.2	....	....	....	....	.....
Guernsey.......	Rosette Ford.....	6.9	21.1	20.2	24.0	27.2	32.4	30.1	34.8	29.8	27.1	23.2	22.2	21.1	18.5	....	....	....	....	.....
Guernsey......	Oriole............	11.6	16.3	21.0	26.6	28.1	29.7	34.7	29.7	27.2	23.2	22.9	22.1	24.1	....	....	....	....	....	.....
Devon	Ione	9.7	20.5	26.2	32.3	27.9	25.4	21.7	20.9	20.1	21.1	....	....	....	....	....	....	....	....	.....
Devon	Genevie's Gift ...	6.6	24.2	22.1	20.2	16.6	16.0	15.1	16.1	....	....	....	....	....	....	....	....	....	....	.....
	Average......	7.2	21.5	23.1	26.1	25.9	25.7	26.2	25.4	26.2	26.1	26.6	26.7	23.8	22.6	24.0	21.9	25.2	24.2	18.5

ALBUMINOIDS NOT AMIDES IN FOOD CONSUMED EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d	26.94	75.63	76,85	64.50	64.62	67.94	60.00	66.25	77.87	84 44	77.69	87.62	79.75	77.69	102.0	89.81	85.25	92.94	......
Ayrshire........	Miss Flow 5th. ..	24.37	53.19	55.00	72.63	69.00	80.00	75.63	55.00	53.06	55.12	58.62	29.43	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess.	8.62	57.50	46.25	53 31	55.06	59.43	56.19	62.19	73.25	79.69	74.31	82.62	75.25	71.37	88.81	56.50	......	......	......
Ayrshire........	Manton Belle ...	21.25	35.12	54.44	68.50	75.31	64.81	75.06	69.75	66.31	89.50	75.56	65.56	39.12	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	13.20	37.60	54.20	56.25	66.25	60.75	57.62	74.06	63.06	62.62	64.44	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	22.62	49.56	44.24	52.81	48.19	53.00	66.25	55.81	52.94	62.25	59.94	59 37	71.44	58.25	52.87	58.62	......	......	......
Jersey	Countess Flavia.	12.10	50.63	68.13	75.00	73 13	60.00	54.37	56 25	59.06	54.56	57.69	69.00	69.37	57.94	65.69	60.81	59.19	66.12	46.69
Jersey	Barbara Allen ..	1.62	37.50	49.06	52.94	55.75	50.12	55.06	65.02	66.19	58.37	70.44	65.69	64.37	81.25	69.00	66.25	71.94	......	......
Am. Holderness	Maggie 6th	4.81	41.93	49.37	55.31	41.06	45.19	52.75	55.19	52.75	59.94	56.37	55.44	69.25	59.44	55.81	67.81	......	......	......
Am. Holderness	Nellie 6th........	12.94	40.75	47.87	44.44	40.44	43.87	45.87	57.25	47.31	28.31	40.69	39.69	49.37	34.81	......	......	......	......	......
Guernsey.......	Rosette Ford...	15.56	46.19	45.00	55.00	61.94	75 81	62.81	70.25	65.69	64.37	81.81	70.12	66.06	56.81	......	......	......	......	......
Guernsey.......	Oriole............	20.12	27.25	44.41	60.62	66.37	61.94	70.00	65.69	64.44	81.50	72.50	69.06	75.06	......	......	......	......	......	......
Devon	Ione	18.94	48.44	55.06	64.81	63.00	59.12	77.31	65.31	62.31	65.25	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	10.69	45.62	45.37	45.50	59.87	49.81	46.56	49.00	......	......	......	......	......	......	......	......	......	......	......
	Average	15.27	46.21	52.52	58.68	60.00	59.41	61.11	61.93	61.86	65.07	65.84	63.05	65.90	62.19	72.53	66.63	72.12	79.53	46.69

CARBOHYDRATES IN FOOD CONSUMED EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d.	102.2	324.6	339.0	348.6	339.5	373.9	416.5	339.7	374.6	344.1	315.7	346.4	358.1	369.7	377.3	477.4	464.6	476.1	......
Ayrshire........	Miss Flow 5th...	152.4	263.3	282.0	362.1	342,3	312.3	317.3	270.2	287.1	289.8	322.0	247.1	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess.	40.4	253.0	238.3	287.9	289.6	327.9	395.9	326.9	359.5	328.0	309.6	328.1	339.3	342.2	332.2	315.8	......	......	......
Ayrshire........	Manton Belle ...	122.0	284.3	301.7	344.4	312.7	272.9	295.4	315.8	324.8	334.5	415.3	377.9	264.5	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	69.4	219.6	229.7	236.4	259.6	272.1	286.2	274.3	340.2	335,3	333.1	......	......	......	......	......	......	......	......
Jersey	Gilderbloom.....	124.7	267.8	266.5	287.4	343.5	282.8	302.5	235.3	224.8	244.6	273.9	294.6	260.3	313.2	297.0	308.6	......	......	......
Jersey	Countess Flavia.	61.5	299.3	206.6	288.3	304.3	282.0	294.2	295.4	323 4	384.9	285.8	336.7	288.2	249.0	259.6	277.7	293.6	247.8	259.3
Jersey	Barbara Allen ..	11.8	204.9	264.9	278.4	306.4	356.4	283.5	323.1	277.3	248.4	279.1	298.0	312.2	297.4	373.5	364.3	368.5	......	......
Am. Holderness	Maggie 6th......	25.6	226.3	259.7	291.8	292.9	240.8	265.6	231.9	223.9	237.6	255.7	269.0	253.2	319.9	305.5	306·1	......	......	......
Am. Holderness	Nellie 6th........	75.9	220.0	252.1	238.4	288.5	233.6	225.3	206.6	192.7	104.3	183.2	193.7	177.7	202.5	......	......	......	......	......
Guernsey.......	Rosette Ford....	82.9	248.8	309.2	282.9	311.5	311.4	266.0	278.6	298.2	312.0	299.4	378.0	262.7	307.7	......	......	......	......	......
Guernsey.......	Oriole...........	112.6	220.9	246.7	304.1	277.7	262.9	277.9	298.1	312 3	298.6	387.1	378.7	381.4	......	......	......	......	......	......
Devon	Ione	99.1	189.9	231.0	254.5	278.5	292.3	281.2	360.5	354.4	344.0	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	52.6	175.5	217.6	234.5	218.9	283.1	271.4	271.8	......	......	......	......	......	......	......	......	......	......	......
	Average	80.9	242.8	260.2	288.5	297.6	293.2	298.5	287.7	299.5	292.8	305.0	313.5	289.8	300.2	324.2	341.6	375.8	361.9	259.3

STARCH AND SUGARS IN FOOD CONSUMED EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d..........	64.1	206.6	225.1	248.5	227.8	251.4	299.1	249.2	264.6	245.8	237.8	237.3	257.8	273.6	213.6	287.4	273.5	277.3	......
Ayrshire........	Miss Flow 5th...	70.7	167.7	163.9	224 5	214.6	192.5	203.8	175.4	200.9	166.4	214.6	166.4	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess.	26.1	161.1	163.1	200.7	188.5	211.0	282.8	237.5	182.1	229.5	227.4	222.7	249.9	252.5	180.9	150.1	......	......	......
Ayrshire........	Manton Belle ...	73.4	193.6	214.0	167.9	213.6	197.2	197.1	224.2	238.7	182.6	235.9	203.5	128.2	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	50.9	82.1	152.5	173.0	174.8	193.3	209.4	152.0	201.6	193.3	191.5	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	87.9	190.6	178.7	196.4	244.9	206.0	212.5	162.9	164.4	166.0	199.9	215.9	145.9	192.0	170.1	178.0	......	......	......
Jersey	Countess Flavia.	39.3	185.9	191.8	181 1	197.0	193.8	212.6	200.3	223.1	275.2	217.4	238.8	203.8	180.7	174.9	198.3	215.3	132.4	80.2
Jersey	Barbara Allen ..	7.9	140.8	185.6	184.4	209.3	243.9	212.5	224.7	187.1	182.4	190.2	217.9	229.9	167.7	224.3	214.5	215.0	......	......
Am. Holderness	Maggie 6th......	22.6	157.3	176.6	192.6	208.9	175.7	187.0	167.0	168.0	162.0	183.9	198.0	142.6	193.8	180.8	185.9	......	......	......
Am. Holderness	Nellie 6th........	54.8	156.9	168.1	159.8	205.9	171.4	164.6	153.0	150.5	59.9	129.4	141.2	98.7	111.6	......	......	......	......	......
Guernsey.......	Rosette Ford....	42.4	157.7	222.6	188.7	150.6	212 0	198 0	189.9	214.2	229.8	168.7	228.0	213.8	173.6	......	......	......	......	......
Guernsey.......	Oriole...........	68.7	149.5	158.2	147.7	197.8	195.6	189.5	214.2	229.9	169.1	236.0	235.0	224.4	......	......	......	......	......	......
Devon	Ione	58.9	124.2	168.9	171.9	198.7	214 2	154.5	212.7	202.9	197.2	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift...	30.2	111.9	153.1	170.6	116.2	161.7	150.7	150.8	......	......	......	......	......	......	......	......	......	......	......
	Average	49.9	156.2	180.1	186.4	196.3	201.4	205.3	193.9	202.2	189.2	202.7	209 5	189.5	193.2	190.8	202.3	234.6	204.8	80.2

CRUDE FIBER IN FOOD CONSUMED EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d..........	54.9	130.9	127.6	137.7	132.4	166.8	143.9	130.2	138.4	162.0	134.8	152.5	130.1	117.3	145.9	163.5	151.6	142.4	......
Ayrshire........	Miss Flow 5th ...	62.6	133.9	138.3	167.9	128.3	142.9	125.5	107.5	117.5	118.9	152.7	119.5	......	......	......	......	......	......	......
Ayrshire.......	Queen Duchess.	21.9	104.1	96.3	118.2	118.7	157.1	141.0	127.9	135.8	159.3	137.1	151,0	128.6	110.8	136.0	137.2	......	......	......
Ayrshire.......	Manton Belle ...	90.6	130.2	123.7	133.2	157.4	124.0	147.6	126.8	108.7	136.5	152.7	136.4	93.3	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	37.3	94.7	119.4	104.9	122.7	108.0	97.5	110.2	118.3	111.8	101.9	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	54.2	104.3	100 4	126.9	117.8	106.8	111.1	114.7	95.5	110.0	105.1	100.6	102.6	104.1	94.6	92.0	......	......	......
Jersey	Countess Flavia.	32.4	141.2	76.3	126.5	118.9	109.4	111.2	112.5	141.4	132.7	108.8	123.9	146.5	110.7	122.0	108.6	99.9	105 7	117.0
Jersey	Barbara Allen ..	5.2	87.5	106.1	110.2	141 2	127.5	114.6	121.9	128.8	108.5	124.2	111.1	102.8	116.1	127.0	117.6	109.7	......	......
Am. Holderness	Maggie 6th	14.2	91.7	97.1	129.4	99 9	90.5	96.7	105.3	93.5	105.0	95.1	88.8	99.4	107.5	98.0	90.8	......	......	......
Am. Holderness	Nellie 6th........	30.5	85.0	97 5	107.2	96 5	80.7	75.7	90.9	75.4	78.9	76.1	66.9	71.1	75.5	......	......	......	......	......
Guernsey.......	Rosette Ford....	45.1	118.3	104.3	107.1	114.1	158.6	113.3	123.9	111.1	102.7	117.2	127.9	117.2	94.3	......	......	......	......	......
Guernsey.......	Oriole...........	77.7	90.0	98.7	112.1	129.1	111.9	123.2	111.1	102.9	115.6	129.4	120,5	112.0	......	......	......	......	......	......
Devon	Ione	52.9	105.9	102.9	119.3	109.2	99.7	114.7	124.7	116.5	104.0	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	31.4	102.4	93.8	84 6	94.3	101.4	92.1	84.9	......	......	......	......	......	......	......	......	......	......	......
	Average	43.7	108.6	105.9	120.3	120.1	120.4	114.3	113.8	114.1	118.9	119.6	119.8	110,4	104.5	120.6	118.3	120.4	124.0	117.0

ASH IN FOOD CONSUMED EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d...........	11.0	35.6	34.1	32.9	33.9	40.4	33.9	33.7	36.5	38.8	33.6	41.6	35.8	38.5	47.6	36.4	35.4	36.6	......
Ayrshire........	Miss Flow 5th...	13.5	26.0	29.1	35.1	36.6	35.1	34.9	28.5	27.8	30.0	36.5	24.7	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess.	4.6	28.0	24.9	27.9	29.9	37.3	32.8	32.5	35.2	37.4	33.1	40.7	34.9	36.0	42.8	25.7	......	......	......
Ayrshire........	Manton Belle....	16.8	27.4	30.2	33.7	36.2	29.4	38.8	33.7	35.5	43.0	32.3	29.6	23.2	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	12.6	21.5	26.9	25.2	33.6	29.3	31.0	35.3	25.9	25.7	25.7	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	13.9	25.3	26.5	31.1	27.6	27.3	28.9	26.7	23.4	30.8	28.7	31.5	33.8	23.3	23.1	23.4	......	......	......
Jersey	Countess Flavia.	8.0	28.9	23.1	32.3	33.5	29.8	27.1	29.3	34.5	31.2	28.5	32.7	32.4	26.3	33.1	29.2	31.3	32.6	21.6
Jersey	Barbara Allen ..	0.6	21.8	25.4	28.3	34.0	29.5	29.0	31.4	30.8	26.2	34.3	30.5	33.0	38.3	28.0	27.5	28.3	......	......
Am. Holderness	Maggie 6th......	2.7	22.0	25.9	32.4	23.4	23.3	25.3	25.4	23.1	29.2	26.2	28.5	32.8	23.9	23.0	23.6	......	......	......
Am. Holderness	Nellie 6th........	6.9	21.0	25.6	26.4	21.8	22.3	20.9	22.6	19.6	19.7	20.5	21.3	23.8	15.4	......	......	......	......	......
Guernsey.......	Rosette Ford....	10.4	28.4	27.2	27.5	29.8	36.4	27.7	34.2	30.5	33.0	38.6	28.4	27.4	23.2	......	......	......	......	......
Guernsey.......	Oriole............	15.0	21.1	24.4	29.2	30.8	27.4	34.1	30.5	33.1	38.2	29.0	28.4	29.3	......	......	......	......	......	......
Devon	Ione	11.6	23,6	24.7	32.6	29.4	31.4	37.5	27.0	26.6	26.2	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	6.0	26.6	24.6	25.6	29.9	21.2	20.5	20.5	......	......	......	......	......	......	.....	......	... ..	......	......
	Average	9.5	25.5	26.6	30.0	30.7	30.0	30.2	29.4	29.4	31.5	30.6	30.6	30.6	28.1	32.9	27.6	31.7	34.6	21.6

The following tables present the milk yield of each animal, the percentage of each constituent, and the pounds of each constituent of the milk yielded during each month of lactation, as also the general averages of each of the above:

MILK YIELD EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d...........	273.0	884.0	895.0	780.6	750.5	725.1	790.1	655.8	638.1	544.7	560.6	683.0	741.6	662.0	612.9	617.2	563.8	540.3	......
Ayrshire.........	Miss Flow 5th...	363.5	626.1	573.6	588.0	591.6	534.4	551.7	449.5	431.5	333.9	173.9	33.5	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess.	99.7	805.7	671.1	701.6	657.8	703.9	747.1	649.0	702.2	662.4	690.6	680.9	673.5	558.0	363.3	122.4	......	......	......
Ayrshire........	Manton Belle....	327.8	649.6	655.4	714.2	688.8	664.5	652.1	657.3	588.7	464.7	385.0	271.1	76.6	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	193.5	453.5	462.6	512.4	487.0	488.9	486.1	427.1	435.8	410.1	434.9	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	341.1	535 6	473.8	410.7	428.4	343.3	342.0	307.1	356.8	315.5	301.0	255.5	204.5	182 2	155.9	164.3	......	......	......
Jersey	Countess Flavia.	171.8	627.7	614.5	580.5	574.0	492.4	474.1	442.7	448.9	449.8	365.8	409.8	409.6	421.7	406.2	408.1	377.9	261.9	87.0
Jersey	Barbara Allen ..	519.0	501.7	494.2	450.6	495.2	409.9	437.4	418.1	432.8	468.3	471.7	444.0	337.1	367.4	340.7	361.9	......	......	......
Am. Holderness	Maggie 6th......	61.2	568.5	585.3	522.9	493.2	413.0	449.4	417.1	428.1	407.6	416.9	391.8	318.2	320.1	267.7	121.3	......	......	......
Am. Holderness	Nellie 6th........	240.3	513.9	531.9	455.4	474.6	420.1	400.6	364.2	387.4	183.1	123.9	......	......	......	......	......	......	......	......
Guernsey.......	Rosette Ford....	195.4	543.4	561.5	482.3	501.9	478.8	515.9	476.1	463.7	452.0	380.4	386.9	347.3	324.3	......	......	......	......	......
Guernsey.......	Oriole............	305.4	440.0	478.4	536.3	557.3	581.3	558.2	577.9	560.6	475.3	521.8	495.5	538.4	......	......	......	......	......	......
Devon	Ione	253.0	432.9	473.7	471.3	460.4	392.4	323.5	346.0	311.9	328.8	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	158.8	403.7	383.1	326.3	265.2	277.9	243.2	291.7	......	......	......	......	......	......	......	......	......	......	......
	Average	250 2	570.6	561.0	538.1	530.4	494.7	498.0	462.8	475.9	422.8	402.2	405.2	405.2	405.1	357.8	299.2	470.9	401.1	87.0

TOTAL SOLIDS IN MILK EACH MONTH OF LACTATION — PER CENT.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d..........	13.47	12.32	12.26	12.36	12.62	12.92	13.12	13.32	13.81	14.33	13.60	13.26	12.40	12.35	12.64	12.89	12.96	12.67	......
Ayrshire........	Miss Flow 5th...	14.85	13.06	13.13	13.18	13.23	13.12	13.31	14.33	13.96	14.98	15.81	17.56	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess	13.51	13.55	13.31	12.77	12.97	13.47	13.45	13.29	13.42	13.13	13.19	13.40	13.30	14.28	14.46	16.34	......	......	......
Ayrshire........	Manton Belle ...	13.32	11.58	11.80	12.60	12.59	12.39	11.82	12.12	12.49	13.07	13.58	14.21	14.44	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	12.82	12.14	12.09	12.16	11.99	12.14	12.34	12.49	12.72	12.86	13.16	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	15.70	14.90	14.50	15.56	15.51	15.19	15.68	15.46	14.83	15.03	14.41	14.56	15.26	16.26	16.31	15.96	......	......	......
Jersey	Countess Flavia.	14.99	14.33	14.91	14.90	14.81	16.15	15.89	16.41	16.48	17.03	16.89	16.99	16.99	16.74	16.95	16.42	16.84	18.95	17.94
Jersey	Barbara Allen ..	14.03	14.23	14.26	15.23	15.33	15.37	15.29	14.91	15.14	14.84	14.63	14.80	15.47	15.92	16.21	16.59	......	......	......
Am. Holderness	Maggie 6th	14.44	12.22	11.82	12.11	12.48	12.38	12.86	12.40	12.20	12.50	12.57	12.81	13.15	13.34	14.03	15.26	......	......	......
Am. Holderness	Nellie 6th........	13.78	12.10	12.06	12.30	12.40	12.83	13.05	12.41	12.96	12.78	12.94	......	......	......	......	......	......	......	......
Guernsey.......	Rosette Ford....	14.79	14.63	14.04	14.20	14.60	14.66	14.47	14.54	14.27	14.95	14.93	16.40	16.34	16.25	......	......	......	......	......
Guernsey.......	Oriole............	15.94	13.83	13.21	13.75	14.07	14.30	14.32	14.18	14.89	15.11	15.85	15.95	16.23	......	......	......	......	......	......
Devon	Ione	13.73	13.36	13.32	13.43	13.65	14.44	14.62	14.84	15.43	15.32	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	12.41	12.66	13.27	14.03	14.44	15.69	16.70	15.70	......	......	......	......	......	......	......	......	......	......	......
	Average	14.13	13.21	13.14	13.45	13.63	13.94	14.07	14.03	14.05	14.30	14.30	14.99	14.84	15.03	15.10	15.58	14.90	15.81	17.94

FAT IN MILK EACH MONTH OF LACTATION — PER CENT.

Breed.	NAME OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian...	Esel 2d...........	4.86	3.64	3.86	3.64	3.66	3.92	3.55	3.73	3.91	3.95	3.72	3.20	2.99	2.92	3.87	3.30	3.11	2.80	......
Ayrshire........	Miss Flow 5th....	5.60	3.96	3.91	4.00	3.80	4.11	4.05	4.37	4.34	4.95	4.80	5.67	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess..	3.96	4.35	4.48	3.91	3.95	3.78	3.60	3.31	3.86	3.72	3.67	3.60	3.72	4.13	3.95	5.30	......	......	......
Ayrshire........	Manton Belle	4.00	3.10	2.82	3.63	3.40	3.28	3.36	3.32	3.42	3.75	3.83	3 52	3.67	......	......	......	......	......	......
Ayrshire........	Junietta P'rless	3.05	2.97	2.94	2.86	2.78	2.72	2.91	3.12	3.09	2.91	2.93	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	6.08	5.62	5.20	6.16	5.47	5.37	5.68	5.62	5.38	5.60	4.91	4.97	5.41	6.22	5.87	6.45	......	......	......
Jersey	Countess Flavia.	5.26	4.84	5.32	5.36	5.37	6.12	6.00	6.41	6.19	6.45	6.35	6.66	6.30	5.87	5.87	5.89	6.32	8.07	6.30
Jersey	Barbara Allen...	4.92	5.05	5.33	5.55	5.70	5.48	5.39	5.46	5.34	4.89	5.15	5.52	5.58	5.41	6.16	6.27	......	......	......
Am. Holderness	Maggie 6th.......	5.30	3.68	3.36	3.63	3.36	3.18	3.41	3.46	3.63	3.87	3.31	3.45	3.78	3.71	3.60	4.75	......	......	......
Am. Holderness	Nellie 6th.........	4.78	3.54	3.35	3.25	3.30	3.47	3.29	3.52	3.56	3.26	3.55	......	......	......	......	......	......	......	......
Guernsey.......	Rosette Ford.....	5.41	5.30	4.74	4.90	5.12	5.03	4.81	4.76	4.74	4.98	5.71	5.93	6.20	6.16	......	......	......	......	......
Guernsey.......	Oriole	6.88	4.94	4.21	4.45	4.90	4.84	4.85	4.95	5.22	5.30	5.65	5.24	5.21	......	......	......	......	......	......
Devon	Ione	3.89	4.03	3.93	3.90	3.93	4.54	4.67	4.45	5.31	4.66	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift...	3.25	3.38	4.00	4.69	4.95	5.09	6.31	5.51	......	......	......	......	......	......	......	......	......	......	......
	Average......	4.92	4.17	4.11	4.28	4.27	4.36	4.42	4.43	4.46	4.48	4.38	4.78	4.76	4.92	4.89	5.33	4.72	5.44	6.30

CASEINE IN MILK EACH MONTH OF LACTATION — PER CENT.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d..........	2.91	2.88	2.83	3.05	3.17	3.58	2.94	2.93	3.67	4.01	3.98	3.74	3.86	3.68	4.29	4.22	3.92	3.39	......
Ayrshire........	Miss Flow 5th ...	3.15	3.23	3.15	3.66	4.08	3.71	3.42	3.55	3.59	4.00	4.48	5.62	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess..	3.60	3.13	2.91	3.06	3.54	3.38	2.95	3.08	3.55	3.43	3.56	3.50	3.76	3.79	4.47	5.63	......	......	......
Ayrshire........	Manton Belle ...	3.42	2.41	3.01	3.13	3.03	3.10	3.07	3.27	3.29	3.68	4.29	3.62	4.21	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	3.32	3.13	2.87	3.55	3.12	3.51	3.32	3.29	4.04	3.44	2.99	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	3.57	3.21	3.47	3.47	3.43	3.41	4.06	3.88	4.01	3.97	4.00	4.21	4.14	4.95	4.26	4.24	......	......	......
Jersey	Countess Flavia.	3.81	3.89	4.13	3.78	3.70	4.04	3.84	3.99	4.16	4.00	4.22	4.79	4.39	4.48	4.43	4.08	4.37	4.44	5.66
Jersey	Barbara Allen ..	3.14	3.28	3.55	3.71	3.16	3.72	4.18	4.00	4.01	3.80	3.94	3.94	3.90	4.81	4.10	4.24	......	......	......
Am. Holderness	Maggie 6th	3.30	2.93	3.17	2.88	2.55	3.00	3.27	3.15	3.45	3.36	3.54	3.75	3.89	4.63	3.60	3.80	......	......	......
Am. Holderness	Nellie 6th........	3.51	2.82	3.23	3.06	2.85	3.26	3.48	3.39	3.76	3.39	4.08	......	......	......	......	......	......	......	......
Guernsey.......	Rosette Ford....	4.45	3.20	3.09	3.48	3.57	3.42	3.85	3.79	3.80	3.99	3.56	4.49	4.61	4.05	......	......	......	......	......
Guernsey.......	Oriole............	3.56	2.56	2.94	3.64	3.45	3.70	3.50	3.70	3.87	4.48	4.58	3.91	4.52	......	......	......	......	......	......
Devon	Ione	4.14	3.21	3.85	3.61	3.85	3.96	3.95	4.54	4.04	3.73	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	3.86	3.33	3.45	3.65	3.56	4.63	3.88	3.26	......	......	......	......	......	......	......	......	......	......	......
	Average	3.55	3.09	3.26	3.41	3.36	3.60	3.56	3.56	3.79	3.79	4.09	4.15	4.14	4.34	4.19	4.37	4.15	3.9^2	5.66

SUGAR IN MILK EACH MONTH OF LACTATION — PER CENT.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian..	Esel 2d..........	5.06	5.12	4.89	4.96	5.31	4.66	5.85	5.93	5.49	5.52	5.22	5.55	4.86	5.00	3.75	4.59	5.11	5.72	......
Ayrshire........	Miss Flow 5th ...	5.45	5.19	5.36	4.92	4.64	4.64	5.19	5.62	5.33	5.45	5.69	5.34	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess.	5.19	5.35	5.25	5.07	4.92	5.59	6.10	6.16	5.36	5.26	5.31	5.53	5.09	5.57	5.26	4.79	......	......	......
Ayrshire........	Manton Belle ...	5.17	5.38	5.28	5.33	5.51	5.41	4.77	5.00	5.16	4.96	4.80	6.34	5.74	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	5.81	5.36	5.56	5.07	5.42	5.21	5.46	5.26	4.88	5.78	6.59	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	5.31	5.33	5.11	5.15	5.80	5.60	5.26	5.14	4.88	4.75	4.75	4.72	4.93	4.33	5.41	4.45	......	......	......
Jersey	Countess Flavia.	5.16	4.84	4.68	5.02	5.00	5.26	5.26	5.09	5.40	5.76	5.52	4.79	5.58	5.64	5.90	5.68	5.46	5.55	5.11
Jersey	Barbara Allen ..	5.27	5.21	4.66	5.25	5.75	5.38	4.99	4.75	5.01	5.46	4.82	4.66	5.24	4.92	5.23	5.37	......	......	......
Am. Holderness	Maggie 6th	5.07	4.85	4.56	4.89	5.85	5.47	5.55	5.06	4.51	4.64	5.00	4.90	4.77	4.29	6.15	5 86	......	......	......
Am. Holderness	Nellie 6th........	5.06	5.08	4.85	5.32	5.52	5.38	5.61	4.81	4.93	5.44	4.51	......	......	......	......	......	......	......	......
Guernsey.......	Rosette Ford ...	4.15	5.41	5.49	5.10	5.17	5.46	5.02	5.32	4.99	5.25	4.93	5.14	4.78	5.28	......	......	......	......	......
Guernsey.......	Oriole...........	4.71	5.53	5.26	4.92	4.97	5.13	5.19	4.81	4.99	4.56	4.88	5.98	5.69	......	......	......	......	......	......
Devon	Ione	4.90	5.29	4.81	5.18	5.08	5.17	5.14	5.05	5.33	6.23	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	4.72	5.21	5.11	4.96	5.06	5.22	5.73	6.19	......	......	......	......	......	......	......	......	......	......	......
	Average	5.07	5.23	5.06	5.31	5.31	5.25	5.31	5.36	5.15	5.41	5.37	5.30	5.19	5.01	5.28	5.12	5.29	5.64	5.11

ASH IN MILK EACH MONTH OF LACTATION — PER CENT.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Ninteenth.
Hol.-Friesian ..	Esel 2d...........	0.64	0.68	0.68	0.71	0.48	0.76	0.78	0.73	0.74	0.85	0.68	0.77	0.69	0.75	0.73	0.78	0.82	0.76	......
Ayrshire........	Miss Flow 5th...	0.65	0.68	0.71	0.60	0.71	0.66	0.65	0.79	0.70	0.58	0.84	0.93	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess .	0.76	0.72	0.67	0.73	0.56	0.72	0.80	0.74	0.65	0.72	0.65	0.77	0.73	0.79	0.78	0.62	......	......	......
Ayrshire........	Manton Belle....	0.73	0.69	0.69	0.51	0.65	0.60	0.62	0.63	0.62	0.68	0.66	0.73	0.82	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	0.64	0.68	0.72	0.68	0.67	0.70	0.65	0.82	0.71	0.73	0.65	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	0.74	0.74	0.72	0.78	0.81	0.81	0.68	0.82	0.56	0.71	0.75	0.76	0.78	0.76	0.77	0.82	......	......	......
Jersey	Countess Flavia.	0.76	0.76	0.78	0.74	0.74	0.73	0.79	0.82	0.73	0.82	0.80	0.75	0.72	0.75	0.75	0.77	0.69	0.89	0.87
Jersey	Barbara Allen...	0.70	0.69	0.72	0.72	0.72	0.79	0.73	0.70	0.78	0.69	0.72	0.68	0.75	0.78	0.72	0.71	......	......	......
Am. Holderness	Maggie 6th	0.77	0.76	0.73	0.71	0.72	0.73	0.63	0.73	0.61	0.63	0.72	0.71	0.71	0.71	0.68	0.85	......	......	......
Am. Holderness	Nellie 6th........	0.43	0.66	0.63	0.67	0.73	0.72	0.67	0.69	0.71	0.69	0.80	......	......	......	......	......	......	......	......
Guernsey.......	Rosette Ford...	0.78	0.72	0.72	0.72	0.74	0.75	0.79	0.67	0.74	0.73	0.73	0.84	0.75	0.76	......	......	......	......	......
Guernsey.......	Oriole...........	0.79	0.80	0.80	0.74	0 75	0.63	0.78	0.72	0.81	0.77	0.74	0.82	0.81	......	......	......	......	......	......
Devon	Ione	0.80	0.83	0.73	0.74	0.79	0.77	0.86	0.80	0.75	0.70	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	0.58	0.74	0.71	0.73	0.87	0.75	0.78	0.74	......	......	......	......	......	......	......	......	......	......	......
	Average	0.70	0.72	0.72	0 70	0.71	0.72	0.74	0.74	0.66	0.67	0.67	0.78	0.75	0.76	0.74	0.76	0.76	0.83	0.87

TOTAL SOLIDS IN MILK EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d..........	36.73	108.91	109.73	97.50	94.71	93.68	103.66	87.35	88.12	78.10	76 20	90.60	91.90	81.80	77.50	79.50	73.00	68.40	......
Ayrshire........	Miss Flow 5th ...	53.98	81.77	75.31	77.50	78.27	70.11	73.42	64.41	60.24	50.02	27.49	5.88	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess.	13.47	109.17	89.32	89 59	85 32	94 81	100.49	86 25	94 24	86.97	91.10	91.20	89.60	79.70	52.50	20.00	......	......	......
Ayrshire........	Manton Belle ...	43.66	75.22	77.34	89.99	86 72	82.30	77.00	79.70	73.50	60.70	52.30	38.50	11.20	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	24.81	55.05	55 92	62 80	58.40	59.40	59.90	53.30	55.40	52.70	57.20	......	......	......	......	....	......	......	......
Jersey	Gilderbloom	53.55	79.80	68.70	63.91	66 45	52.15	53.63	47.48	52.90	47.40	43 40	37.50	31.20	29.60	25.40	26,20	......	......	......
Jersey	Countess Flavia.	25.75	89.95	91 62	86.49	85.01	79 52	75.33	72.65	73.98	76.60	61 78	69.62	69.59	70.60	68.80	67.00	63.60	49.60	15.60
Jersey	Barbara Allen ..	72.82	71.39	70.47	68.63	75.91	63.00	66.88	63.34	65.50	69.50	69.00	65.70	52.10	58.50	55.20	60.00	......	......	......
Am. Holderness	Maggie 6th	8.84	69.47	69.18	63.32	61.55	51.13	57.79	51.72	52.20	50.90	52 40	50.20	41.80	42.70	37.50	18.50	......	......	......
Am. Holderness	Nellie 6th........	33.11	62.18	64 10	56 01	58.85	53.90	52.28	45.20	50.20	23.40	16.00	......	......	.....	......	......	......	......	......
Guernsey.......	Rosette Ford....	28.90	79.50	78.83	68 49	73.28	70.19	74.60	69.20	66.20	67.60	56.80	63 40	56.70	52.70	......	......	......	......	......
Guernsey.......	Oriole............	48.68	60.85	63.20	73.74	78.41	83.10	79.90	81.90	83.50	71.80	82.70	79.00	87.40	......	......	......	......	......	......
Devon	Ione	34.70	57.80	63.10	63.30	62.80	56 70	47.30	51.30	48.10	50.40	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	19.70	51.10	50.80	45 80	38.30	43.60	40.60	45.80	......	......	......	......	......	......	......	......	......	......	......
	Average	35.62	75.16	74.40	71.90	71 71	68.09	68.77	64.26	66.47	60.47	57.20	59.16	59.06	59.37	52.82	45.20	68.30	59.00	15.60

FAT IN MILK EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d	13.27	32.18	34.55	28 41	27.46	28.42	28.05	24.46	24.95	21.52	20.80	21.90	22.20	19.30	23.70	20.40	17.50	15.10	......
Ayrshire........	Miss Flow 5th...	20.35	24.79	22.43	23.52	22.48	21.96	22.34	19.64	18.73	16.53	8.35	1.90	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess.	3.95	35.05	30.06	27.43	25.98	26.61	26.90	21 48	27.10	24.64	25.30	24.50	25.10	23.00	14.40	6.50	......	......	......
Ayrshire........	Manton Belle....	13.11	20.14	18.48	25.93	23.42	21.80	21.90	21 20	20.10	17.40	14.70	9.50	2.80	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	5.90	13.47	13.60	14.60	13.50	13.30	14.10	13.30	13.50	11.90	12.70	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	20.74	30.10	24.64	25.30	23.43	18.44	19.42	17.26	19.20	17.70	14.80	12.70	11.00	11.30	9.20	10.60	......	......	......
Jersey	Countess Flavia.	9.04	30.28	32.69	31.11	30.82	30.13	28.45	28.39	27.79	29.01	23.23	27.29	25.80	24.80	23.80	24.00	23.90	21.10	5.50
Jersey	Barbara Allen ..	25.53	25.33	26.34	25.01	28.23	22.46	23.58	22 83	23.10	22.90	24 30	24.50	18.80	19 90	21.00	22.70	......	......	......
Am. Holderness	Maggie 6th......	3 24	20.92	19.67	18.98	16.57	13.18	15.32	14.43	15.50	15.80	13.80	13.50	12.00	11.90	9.60	5.80	......	......	......
Am. Holderness	Nellie 6th........	11.49	18 19	17.82	14.80	15.66	14.58	13.18	12.82	13.80	6.00	4.40	......	......	......	......	......	......	......	......
Guernsey.......	Rosette Ford....	10.57	28.80	26.61	23.63	25.70	24.08	24.80	22.70	22.00	22.50	21.70	22.90	21.50	20.00	......	......	......	......	......
Guernsey.......	Oriole............	21.01	21.73	20.14	23.87	27.31	28.10	27.10	28.60	29.30	25.20	29.50	26.00	28.10	......	......	......	......	......	......
Devon	Ione	9.80	17.40	18.60	18.40	18.10	17.80	15.10	15.40	16.60	15.30	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift..	5.20	13.70	15.30	15.30	13.10	14.10	15.40	16 10	......	......	......	......	......	......	......	......	......	......	......
	Average......	12.38	23.72	22.92	22.59	22.27	21.07	22.12	19.90	20.90	18.94	17.80	18.47	18.59	18.60	17.00	15.00	20.70	18.10	5.50

CASEINE IN MILK EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d..........	7.94	25.46	25.32	23.80	23.79	25.96	23.23	19.22	23.42	21.82	22.30	25.50	28.60	24.40	26.30	26.00	22.10	18.30	......
Ayrshire........	Miss Flow 5th ...	11.45	21.22	18.07	21.52	24.13	19.83	18.86	15.95	15.49	13.36	7.79	1.88	......	......	......	......	......	.....	......
Ayrshire........	Queen Duchess.	3.59	25.22	19.53	21.47	23.29	23.79	22.04	19.99	24.93	22.72	24.60	23.80	25.30	21.20	16.20	6.90	......	......	......
Ayrshire........	Manton Belle....	11.21	15.65	19.73	22.35	20.87	20.60	20.00	21.50	19.40	17.10	16.50	9.80	3.30	......	......	......	......	......	......
Ayrshire	Junietta P'rless.	6.42	14.19	13.28	18.20	15.20	17.20	16.10	14.00	17.60	14.10	13.80	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	12.18	17.19	16.44	14.25	14.69	11.71	13.89	11.92	14.30	12.50	12.00	10.80	8.50	9.00	6.60	7.00	......	......	......
Jersey	Countess Flavia.	6.55	24.42	25.38	21.94	21.23	19.89	18.20	17.56	18.67	17.99	15.44	19.63	17.98	18.90	18.00	16.70	16.50	11.60	4.90
Jersey	Barbara Allen ..	16.30	16.46	17.54	16.72	15.64	15.25	18.28	16.72	17.40	17.80	18.60	17.50	13.10	17.70	14.00	15.30	......	......	......
Am. Holderness	Maggie 6th	2.01	16.66	18.55	15.05	12.58	12.39	14.70	13.14	14.80	13.70	14.80	14.70	12.40	14.80	9.60	4.60	......	......	......
Am. Holderness	Nellie 6th........	8.43	14.49	17.18	13.93	13.52	13.69	13.94	12.35	14.60	6.20	5.00	......	......	......	......	......	......	......	......
Guernsey	Rosette Ford	8.70	17.39	17.35	16.78	17.92	16.37	19.90	18.00	17.60	18.00	13.50	17.40	16.00	13.10	......	......	......	......	......
Guernsey.......	Oriole............	10.87	11.26	14.07	19.52	19.23	21.50	19.50	21.40	21.70	21.30	23.90	19.40	24.30	......	......	......	......	......	......
Devon	Ione	10.50	13.90	18.20	17.00	17.70	15.60	12.80	15.70	12.60	12.30	......	......	......	......	.....	......	......	......	......
Devon	Genevie's Gift...	6.10	13.40	13.20	11.90	9.50	12.90	9.40	9.50	......	......	......	......	......	......	......	......	......	......	......
	Average	8.73	17.64	18.13	18.53	17.80	17.62	17.20	16.22	16.53	15.26	15.69	16.04	16.61	17.02	15.12	12.75	19.30	14.90	4.90

SUGAR IN MILK EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.*	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d..........	13.81	45.26	43.76	38.72	39.85	33.79	46.22	38.89	35 03	30.07	29.30	37.90	36.00	33.10	23.00	28.30	28.80	30.90	......
Ayrshire........	Miss Flow 5th ...	19.81	32.50	30.74	28.93	27.45	24.80	28.63	25.26	23.00	18.20	9.90	1.80	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess.	5.17	43.10	35.23	35.57	32.36	39.35	45.57	39.98	37.64	34.84	36.70	37.70	34.30	31.10	19.10	5.90	......	......	......
Ayrshire........	Manton Belle ...	16.95	34.95	34.61	38.07	37.95	35.90	31.10	32.90	30.40	23.00	18.50	17.20	4.50	......	......	......	......	......	......
Ayrshire........	Junietta P'rless.	11.24	24.31	25.72	26.00	26.40	25.50	26.50	22.50	21.20	23.70	28.70	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	18.11	28.55	24.21	21.15	25.25	19.22	17.99	15.78	17.40	15.00	14.30	12.10	10.10	7.90	8.40	7.30	......	......	......
Jersey	Countess Flavia.	8.87	30.38	28.76	29.14	28.70	25.90	24.94	22.98	24.24	25 91	20.19	19.63	22.86	23.50	24.00	23.20	20.60	14.60	4.40
Jersey	Barbara Allen...	27.35	26.14	23.03	23.66	28.47	22.05	21.83	19.86	21.70	25.60	22.70	20.70	17.70	18.10	17.80	19.40	......	......	......
Am. Holderness	Maggie 6th	3.13	27.57	26.69	25.57	28.85	22.59	24.94	21.10	19.30	18.90	20.80	19.20	15.20	13.70	16.50	7.10	......	......	......
Am. Holderness	Nellie 6th........	12.16	26.11	25.80	24.23	26.20	22.60	22.47	17.52	19.10	10.00	5.60	......	......	......	......	......	......	......	......
Guernsey.......	Rosette Ford....	8.11	29.40	30.83	24.60	25.95	26.14	25.90	25.30	23.10	23.70	18.80	19.90	16.60	17.10	......	......	......	......	......
Guernsey.......	Oriole............	14.38	24.33	25.16	26.39	27.70	29.80	29.00	27.80	28.00	21.70	25.50	29.60	30.60	......	......	......	....	......	......
Devon	Ione	12.40	22.90	22.80	24.40	23.40	20.30	16.60	17.50	16.60	20.50	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ..	7.50	21.00	19.60	16.20	13.40	14.50	13.90	18.00	......	......	......	......	......	......	......	......	......	......	......
	Average	12.79	29.76	28.35	27.33	28.00	25.89	23.96	22.31	22.91	23.96	20.92	21.58	20.87	20.64	18.13	15.20	24.70	22.70	4.40

ASH IN MILK EACH MONTH OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d	1.70	6.00	6.10	5.50	3.60	5.50	6.20	4,80	4.70	4.60	3.80	5.30	5.10	5.00	4.50	4.80	4.60	4.10	......
Ayrshire........	Miss Flow 5th....	2.40	4.30	4.10	3.50	4.20	3.50	3.60	3.60	3.00	1.90	1.50	0.30	......	......	......	......	......	......	......
Ayrshire........	Queen Duchess..	0.80	5.80	4.50	5.10	3.70	5.10	6.00	4.80	4.60	4.80	4.40	5.20	4.90	4.40	2.80	0.70	......	......	......
Ayrshire........	Manton Belle	2.40	4.50	4.50	3.60	4.50	4.00	4.00	4.10	3.60	3.20	2.50	2.00	0.60	......	......	......	......	......	......
Ayrshire........	Junietta Peerless	1.20	3.10	3.30	3.50	3.30	3.40	3.20	3.50	3.10	3.00	2.80	......	......	......	......	......	......	......	......
Jersey	Gilderbloom	2.50	4.00	3.40	3.20	3.50	2.80	2.30	2.50	2.00	2.20	2.30	1.90	1.60	1.40	1.20	1.30	......	......	......
Jersey	Countess Flavia.	1.30	4.80	4.80	4.30	4.20	3.60	3.70	3.60	3.30	3.70	2.90	3.10	2.90	3.20	3.00	3.10	2.60	2.30	0.80
Jersey	Barbara Allen ...	3.60	3.50	3.60	3.20	3.60	3.20	3.20	2.90	3.40	3.20	3.40	3.00	2.50	2.80	2.40	2.60	......	......	......
Am. Holderness	Maggie 6th.......	0.50	4.30	4.30	3.70	3.60	3.00	2.80	3.00	2.60	2.50	3.00	2.80	2.20	2.30	1.80	1.00	......	......	......
Am. Holderness	Nellie 6th.........	1.00	3.40	3.40	3.10	3.50	3.00	2.70	2.50	2.70	1.20	1.00	......	......	......	......	......	......	......	......
Guernsey.......	Rosette Ford.....	1.50	3.90	4.00	3.50	3.70	3.60	4.10	3.20	3.40	3.30	2.80	3.20	2.60	2.50	......	......	......	......	......
Guernsey.......	Oriole	2.40	3.50	3.80	4.00	4.20	3.70	4.30	4.10	4.50	3.60	3.80	4.00	4.40	......	......	......	......	......	......
Devon	Ione	2.00	3.60	3.50	3.50	3.60	3.00	2.80	2.70	2.30	2.30	......	......	......	......	......	......	......	......	......
Devon	Genevie's Gift ...	0.90	3.00	2.70	2.40	2.30	2.10	1.90	2.20	......	......	......	......	......	......	......	......	......	......	......
	Average......	1.73	4.12	4.00	3.72	3.68	3.54	3.64	3.39	3.32	3.04	2.86	3.08	2.98	3.08	2.61	2.25	3.60	3.20	0.80

The following tables present for each breed the average pounds of each food constituent consumed for each month of lactation:

AVERAGE CRUDE FATS IN FOOD CONSUMED BY BREEDS IN EACH MONTH OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	8.4	29.0	28.5	30.3	27.8	29.9	27.3	29.1	33.1	35.3	35.2	42.9	35.8	32.2	29.1	28.2	27.1	29.8	......
Ayrshire	8.2	21.4	22.9	28.4	30.2	28.6	29.6	26.1	26 2	25.5	26.6	27.0	23.2	29.8	25.1	15.7	......	......	......
Jersey	5.5	22.1	24.2	24.0	25.1	24.2	25.6	25.5	26.5	28.2	29.2	28.3	25.6	23.4	24.0	22.6	24.2	18.6	18.5
American Holderness	4.3	19.2	20.4	23.0	19.3	20.2	21.4	22.1	23.2	22.8	22.2	20.3	16.8	15.0	17.8	19.3	......	.....	......
Guernsey	9.3	18.7	20.6	25.3	27.6	31.1	32.4	32.3	28.5	25.2	23.1	22.2	22.6	18.5	......	......	......	......	......
Devon	8.1	22.3	24.2	26.3	22.3	18.2	18.4	18.5	20.1	21.1	......	......	......	......	......	......	......	......	......
Average	7.3	22.1	23.5	26.2	25.4	25.4	25.8	25.6	26.3	26.3	27.3	28.1	24.8	23.8	24.0	21.4	25.6	24.2	18.5

AVERAGE ALBUMINOIDS NOT AMIDES IN FOOD CONSUMED BY BREEDS EACH MONTH OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	26.94	75.63	76.85	64.50	64.62	67.94	60.00	66.25	77.87	84.44	77.69	87.62	79.75	77.69	102.00	89.81	85.25	92.94	......
Ayrshire	16.86	45.85	52.47	62.67	66.41	66.25	66.13	65.23	63.92	71.73	68.23	59.20	57.18	71.37	88.81	56.50	......	......	......
Jersey	12.11	45.90	53.81	60.25	59.02	54.37	58.56	59.03	59.40	58.39	62.69	64.69	68.39	65.81	62.52	61.89	65.56	66.12	46.69
American Holderness	8.88	41.34	48.62	49.88	40.75	44.53	49.31	56.22	50.03	44.12	48.53	47.57	59.31	47.12	55.81	67.81	......	......	......
Guernsey	17.84	36.72	44.71	57.81	64.15	68.87	66.40	67.97	65.07	72.94	77.15	69.59	70.56	56.81	......	......	......	......	......
Devon	14.82	47.03	50.22	55.16	61.44	54.46	61.93	57.15	62.31	65.25	......	......	......	......	......	......	......	......	......
Average	16.24	48.75	54.78	58.38	59.40	59.40	60.39	61.97	63.10	66.15	66.86	65.73	66.88	63.75	77.28	69.00	75,40	79.53	46.69

AVERAGE CARBOHYDRATES IN FOOD CONSUMED BY BREEDS EACH MONTH OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	102.2	324.6	339.0	348.6	339.5	373.9	416.5	339.7	374.6	344.1	315 7	346 4	358.1	369.7	377.3	477.4	464.6	476.1	......
Ayrshire	96.1	255.1	262.9	307.7	301.1	296.3	323.7	296.8	327.9	321.9	345.0	317.7	301,9	342.2	332.2	315.8	......	......	......
Jersey	66.0	257.3	245.7	284.7	318.1	307.1	293.4	284 6	275.2	392.6	279.6	309.8	286.9	286.5	310.0	316.9	331.0	247.8	259.3
American Holderness	50.8	223.2	255.9	265.1	290.7	237.2	245.5	219.2	208.3	170.9	219.5	231.4	215.5	261.2	305.5	306,1	......	......	......
Guernsey	97.8	234.9	277.9	293.5	294.6	287.1	271.9	283.4	305.3	305 3	343.3	378.4	322.0	307.7	......	......	......	......	......
Devon	75.8	182.7	224.3	244.5	248.7	287.7	276.3	316.1	354,4	344.0	......	......	......	......	......	......	......	......	......
Average	81.5	246 3	267.6	290.7	298.8	298.2	304.5	290.0	307.6	296.5	300.6	316.7	296.9	313.5	331.2	354.0	397.8	362.0	259.3

AVERAGE SUGAR AND STARCH IN FOOD CONSUMED BY BREEDS EACH MONTH OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth,	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	64.1	206.6	225.1	248.5	227.8	251.4	299.1	249.2	264.6	245.8	237.8	237.3	257.8	273.6	213.6	287.4	273 5	277.3	......
Ayrshire	55.3	151.1	173.4	191.5	197.9	198.5	223.2	197.3	205.8	192.8	217.3	197.5	189.0	252 5	180.9	150.1	......	......	......
Jersey	45.0	172.4	185.4	187.3	217.1	214.6	212.5	196.0	191.5	207.9	202.5	224.2	193.2	180.1	189.8	196.9	215.1	132.4	80.2
American Holderness	38.7	157.1	172.4	176.2	207.4	173.5	175.8	160.0	159.2	110.9	156.7	169.6	120.7	152.7	180.8	185.9	......	......	......
Guernsey	55.6	153.6	190.4	168.2	174.2	203.8	193.7	202.0	222.1	199.5	202.3	231.5	219.1	173.6	......	......	......	......	......
Devon	44.6	118.1	161.0	171.3	157.5	188.0	152.6	181.7	202.9	197.2	......	......	......	......	......	......	......	......	......
Average	50.5	159.8	184.6	190.5	197.0	205.0	209.5	197.7	207.7	192.3	203.3	212.0	196.0	206.5	191.3	205.1	244.3	204.8	80.2

AVERAGE CRUDE FIBER IN FOOD CONSUMED BY BREEDS EACH MONTH OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	54.9	130.9	127.6	137.7	132.4	166.8	143.9	130.2	138.4	162.0	134.8	152.5	130.1	117.3	145.9	163.5	151.6	142.4	......
Ayrshire	53.1	115.7	119.4	131.1	131.8	133.0	127.9	118.1	120.1	131.6	136.1	135.6	110.9	110.8	136 0	137.2	......	......	......
Jersey	30.6	111.0	94.3	121.2	126.0	114.6	112.3	116.4	121.9	117.1	112.7	111.9	117.3	110.3	114.5	106.1	104.8	105 7	117.0
American Holderness	22.4	88.3	97.3	118.3	98.2	85.6	86.2	98.1	84.4	91.9	85.6	77.9	85.3	91.5	98.0	90.8	......	......	......
Guernsey	61.4	104.2	101.5	109.6	121.6	135.2	118.3	117.5	107.0	109.2	123.3	124.2	114.6	94.3	......	......	......	......	......
Devon	42.1	104.1	98.4	102.0	101.8	100.6	103.4	104.8	116.5	104.0	......	......	......	......	......	......	......	......	......
Average	44.1	109.0	106.4	120 0	118.6	122.6	115.3	114.2	114.7	119.3	118.5	120.4	111.6	104.8	123.6	124.4	128.2	124.0	117.0

AVERAGE ASH IN FOOD CONSUMED BY BREEDS EACH MONTH OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	11.0	35.6	34.1	32.9	33.9	40.4	33.9	33.7	36.5	38.8	33.6	41.6	35.8	38.5	47.6	36.4	35.4	36.6	......
Ayrshire	11.9	25.7	27.8	30.5	34.1	32.8	34.4	32.5	31.1	34.0	31.9	31.7	29.0	36.0	42.8	25.7	......	......	......
Jersey	7.5	25.3	25.0	30.6	31.7	28.9	28.3	29.1	29.6	29.4	30.5	31.6	33.1	29.3	28.1	26.7	29.8	32.6	21.6
American Holderness	4.8	21.5	25.7	29.4	22.6	22.8	23.1	24.0	21.3	24.5	23.4	24.9	28.3	19.7	23.0	23.6	......	......	......
Guernsey	12.7	24.8	25.8	28.4	30.3	31.9	30.9	32.4	31.8	35.6	33.8	28.4	28.3	23.2	......	......	......	......	......
Devon	8.8	25.1	24.7	29.1	29.7	26.3	29.0	23.7	26.6	26.2	......	......	......	......	......	......	......	......	......
Average	9.5	26.3	27.2	30.1	30.4	30.5	29.9	29.2	29.5	31.4	30.6	31.6	30.9	29.3	35.4	28.1	32.6	34.6	21.6

The following tables present for each breed, the average milk yield, the average per cent of each milk constituent, the average pounds of each milk constituent for each month of lactation:

AVERAGE MILK YIELD BY BREEDS EACH MONTH OF LACTATION.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	273.0	884.0	895 0	780.6	750.5	725.1	790.1	655.8	638.1	544.7	560.6	683.0	741.6	662 0	612.9	617.2	563.8	540.3	......
Ayrshire	246.1	633.7	590.7	629.1	606.3	597.9	609.3	545.7	539.6	467.8	421.1	328.5	375.1	558.0	363.3	122.4	......	......	......
Jersey	344.0	555.0	527.5	480.6	499.2	415.2	417.8	389 3	412.8	411.2	379.5	369.8	317.1	323.8	300.9	311.4	377.9	261.9	87.0
American Holderness	150.8	541.2	558.6	489.1	483.9	416.6	425.0	390.7	407.8	295.3	270.4	391.8	318.2	320.1	267.7	121.3	......	......	......
Guernsey	250.4	491.7	520.0	509.3	529.6	530.1	537.1	527.0	512.2	463.7	451.1	441.2	442.9	324.3	......	......	......	......	......
Devon	205.9	418.3	428.4	398.8	362.8	335.2	283.3	318.9	311.9	328.8	......	......	......	......	......	......	......	......	......
Average	245.0	587.3	586.7	547.9	538.7	503.3	510.4	471.2	470.4	418.6	416.5	442.9	439.0	437.6	386.2	293.1	470.9	401.1	87.0

AVERAGE TOTAL SOLIDS IN MILK BY BREEDS EACH MONTH OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	13.47	12.32	12.26	12.36	12.62	12.92	13.12	13.32	13.81	14.33	13.60	13.26	12.40	12.35	12.64	12.89	12.96	12.67	.....
Ayrshires	13.63	12.58	12.58	12.68	12.70	12.78	12.73	13.06	13.15	13.51	13.94	15.06	13.87	14.28	14.46	16.34	......	......	......
Jerseys	14.91	14.48	14.56	15.23	15.22	15.57	15.62	15.59	15.48	15.63	15.31	15.48	15.91	16.31	16.49	16.32	16.84	18.95	17.94
American Holderness	14.11	12.16	11.94	12.21	12.44	12.61	12.96	12.41	12.58	12.64	12.76	12.81	13.15	13.34	14.03	15.26	......	......	......
Guernseys	15.37	14.23	13.63	13.98	14.34	14.48	14.40	14.36	14.53	15.03	15.39	16.18	16.29	16.25	......	......	......	......	......
Devons	13.07	13.01	13.30	13.73	14.05	15.07	15.66	15.27	15.43	15.32	......	......	......	......	......	......	......	......	......
Average	14.09	13.13	13.04	13.36	13.56	13.90	14.08	14.00	14.17	14.41	14.20	14.55	14.32	14.50	14.40	15.20	14.90	15.81	17.94

AVERAGE FAT IN MILK BY BREED EACH MONTH OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian..................	4.86	3.64	3.86	3.64	3.66	3.92	3.55	3.73	3.91	3.95	3.72	3.20	2.99	2.92	3.87	3.30	3.11	2.80	......
Ayrshires..........................	4.15	3.59	3.54	3.60	3.48	3.47	3.48	3.50	3.68	3.83	3.76	3.93	3.69	4.13	3.95	5.30	......	......	......
Jerseys	5.42	5.17	5.28	5.69	5.51	5.66	5.69	5.83	5.63	5.65	5.47	5.71	5.76	5.80	5.96	6.20	6.32	8.07	6.30
American Holderness	5.04	3.61	3.35	3.44	3.33	3.32	3.35	3.49	3.59	3.56	3.43	3.45	3.78	3.71	3.60	4.75	......	......	......
Guernseys..........................	6.14	5.12	4.47	4.67	5.01	4.93	4.83	4.85	4.98	5.14	5.68	5.58	5.70	6.16	......	......	......	......	......
Devons.............................	3.57	3.70	3.96	4.29	4.44	4.81	5.49	4.98	5.31	4.66	......	......	......	......	......	......	......	......	......
Average	4.86	4.13	4.07	4.22	4.23	4.35	4.39	4.39	4.51	4.46	4.41	4.37	4.38	4.54	4.34	4.88	4.71	5.43	6.30

AVERAGE CASEINE IN MILK BY BREEDS EACH MONTH OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	2.91	2.88	2.83	3.05	3.17	3.58	2.94	2.93	3.67	4.01	3.98	3.74	3.86	3.68	4.29	4.22	3.92	3.39	......
Ayrshires	3.37	2.97	2.98	3.35	3.44	3.42	3.19	3.29	3.61	3.63	3.83	4.24	3.98	3.79	4.47	5.63	......	......	......
Jerseys	3.50	3.46	3.71	3.98	3.43	3.72	4.02	3.95	4.06	3.92	4.05	4.31	4.14	4.74	4.26	4.18	4.37	4.44	5.66
American Holderness	3.40	2.87	3.20	2.97	2.70	3.13	3.37	3.27	3.60	3.37	3.81	3.75	3.89	4.63	3.60	3.80	......	......	......
Guernseys	4.00	2.88	3.01	3.56	3.51	3.56	3.67	3.74	3.83	4.23	4.07	4.20	4.56	4.05	......	......	......	......	......
Devons	4.00	3.27	3.65	3.63	3.70	4.29	3.91	3.90	4.04	3.73	......	......	......	......	......	......	......	......	......
Average	3.53	3.05	3.23	3.42	3.32	3.61	3.51	3.51	3.80	3.81	3.94	4.04	4.08	4.17	4.15	4.45	4.14	3.91	5.66

AVERAGE SUGAR IN MILK BY BREEDS EACH MONTH OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	5.06	5.12	4.89	4.96	5.31	4.66	5.85	5.93	5.49	5.52	5.22	5.55	4.86	5.00	3.75	4.59	5.11	5.72	......
Ayrshire	5.40	5.32	5.35	5.09	5.12	5.21	5.38	5.51	5.18	5.36	5.59	5.73	5.41	5.57	5.26	4.79	......	......	......
Jersey	5.24	5.12	4.81	5.14	5.52	5.41	5.17	5.03	5.10	5.32	5.03	4.72	5.25	4.96	5.51	5.17	5.46	5.55	5.11
American Holderness	5.06	4.97	4.71	5.11	5.69	5.68	5.58	4.94	4.72	5.04	4.76	4.90	4.77	4.29	6.15	5.86	.....	......	......
Guernsey	4.43	5.47	5.38	5.01	5.07	5.30	5.11	5.07	4.99	4.91	4.91	5.56	5.24	5.28	......	......	......	.....	......
Devon	4.81	5.25	4.96	5.07	5.07	5.20	5.44	5.62	5.33	6.23	......	......	.....	......	......	.....	.....	......	......
Average	5.00	5.20	5.01	5.06	5.29	5.24	5.42	5.35	5.13	5.39	5.10	5.29	5.10	5.02	5.16	5.10	5.28	5.63	......

Average Ash in Milk by Breeds Each Month of Lactation — Per Cent.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	0.64	0.68	0.68	0.71	0.48	0.76	0.78	0.73	0.74	0.85	0.68	0.77	0.69	0.75	0.73	0.78	0.82	0.76	......
Ayrshire	0.70	0.69	0.70	0.63	0.65	0.67	0.68	0.75	0.67	0.68	0.70	0.81	0.78	0.79	0.78	0.62	......	......	......
Jersey	0.73	0.73	0.74	0.75	0.76	0.78	0.73	0.78	0.69	0.74	0.76	0.73	0.75	0.76	0.75	0.77	0.69	0.89	0.87
American Holderness	0.60	0.71	0.68	0.69	0.73	0.73	0.65	0.71	0.66	0.66	0.76	0.71	0.71	0.71	0.68	0.85	......	......	......
Guernsey	0.79	0.76	0.76	0.73	0.75	0.69	0.79	0.70	0.78	0.75	0.74	0.83	0.78	0.76	......	......	......	......	......
Devon	0.69	0.79	0.72	0.74	0.83	0.76	0.82	0.77	0.75	0.70	......	......	......	......	......	.....	......	......	......
Average	.69	.72	.71	.70	.70	.73	.74	.74	.71	.73	.72	.77	.74	.75	.74	.75	.75	.82	.87

AVERAGE TOTAL SOLIDS IN MILK BY BREEDS EACH MONTH OF LACTATION — POUNDS.

BREED.	First.*	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	36.73	108.91	109.73	97.50	94.71	93.68	103.66	87.35	88.12	78.10	76.20	90.60	91.90	81.80	77.50	79.50	73.00	68.40	......
Ayrshire	33.98	80.30	74.47	79.84	77.18	76.66	77.70	70 91	70.84	62.60	57.02	45.29	50 40	79.70	52.50	20.00	......	......	......
Jersey	50.71	80.38	76.93	73.01	75.79	64.89	65.28	61.16	64.13	64.50	58.06	57.61	50.96	52.90	49.80	51.10	63.60	49.60	15.60
Guernsey	20.98	65.83	66.64	59.67	60.20	52.52	55.03	48.46	51.20	37.15	34.20	50.20	41.80	42.70	37.50	18.50	......	......	......
American Holderness	38.79	70.18	71.02	71.11	75.85	76.64	77.25	75.55	74.85	69.70	69.75	71.20	72.05	52.70	......	......	......	......	......
Devon	27.20	54.45	56.95	54.55	50.55	50.15	43 95	48.55	48 10	50.40	......	......	......	......	......	......	......	......	......
Average	34.73	76.68	75.96	72.61	72.38	69 09	70.48	65.33	66.21	60.41	59.05	62.98	61.42	61.96	54.32	42 28	68.30	59.00	15.60

* The first month is in every case the remainder of the month after calving.

AVERAGE FATS IN MILK BY BREEDS EACH MONTH OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	13.27	32.18	34.55	28 41	27.46	28.42	28.05	24.46	24 95	21.52	20.80	21.90	22.20	19.30	23.70	20.40	17.50	15.10	......
Ayrshire	10 83	23 36	21.14	22 87	21.34	20.92	21.31	18 91	19.86	17 62	15.26	11.97	13 90	23.00	14.40	6.50	......	......	......
Jersey	18.44	28.57	27.89	27 14	27.49	23.68	23.82	22.83	23 36	23.21	20.77	21.50	18.53	18.67	18.00	19 10	23 90	21.10	5.50
American Holderness	7 37	19 56	18.75	16.89	16.12	13.88	14.25	13.63	14.65	10.90	9 10	13.50	12.00	11.90	9.60	14 20	......	......	......
Guernsey	15.79	25.27	23 38	23.75	26.51	26.09	25.95	25.65	25 65	23 85	25.60	24 40	24.80	20 00	......	......	......	......	......
Devon	7 50	15.55	16.95	16.85	16.60	15 95	15.20	15.80	16.60	15.30	......	......	......	......	......	......	......	......	......
Average	12.20	24.08	23.78	22 65	22.59	21.49	21.43	20.21	20 84	18.73	18.31	18.65	18.29	18 57	16.42	15.05	20.70	18.10	5.50

AVERAGE CASEINE IN MILK BY BREEDS EACH MONTH OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	7.94	25 46	25.32	23.80	23,77	25.96	23.23	19.22	23 42	21.82	22 30	25.50	28.60	24.40	26.30	26.00	22.10	18.30	......
Ayrshire	8.17	19.07	17.65	20.88	20.87	20 36	19.25	17.86	19 36	16.82	15.47	11 83	14.30	21 20	16.20	6.90	......	......	......
Jersey	11.68	19 36	19.79	17.64	17.19	15.62	16.79	15.40	16.79	16 10	15.35	15.98	13.19	15 20	12.87	13.00	16.50	11 60	4.90
American Holderness	5.22	15.58	17.87	14 49	13 05	13.04	14.32	12.75	14.70	9.95	9.90	14 70	12.40	14.80	9 60	4 60	......	......	......
Guernsey	9.79	14.33	15.71	18.15	18.58	18.93	19.70	19.70	19.65	19.65	18.70	18.40	20.10	13.10	......	......	......	......	......
Devon	8.30	13 65	15.70	14.45	13.60	14.25	11.10	12.60	12.60	12.30	......	......	......	......	....	......	......	......	......
Average	8.52	17.91	18.67	18.24	17.84	18.03	17.40	16.26	17.75	16.11	16.34	17.28	17.72	17.74	16.24	12.62	19.30	14.95	4.90

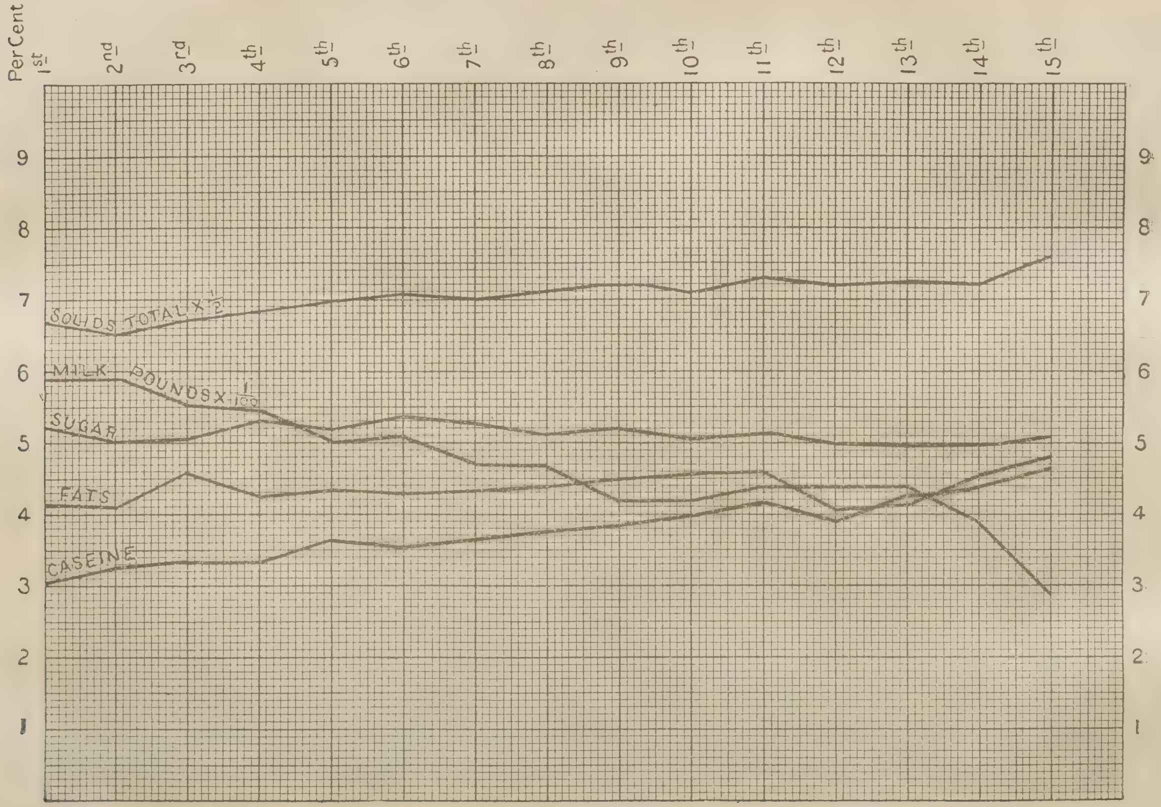
AVERAGE SUGAR IN MILK BY BREEDS EACH MONTH OF LACTATION—POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	13.81	45.26	43.76	33.72	39.85	33.79	46.22	38.89	35.03	30.07	29.30	37.90	36.00	33.10	23 00	28.30	28.80	30.90	......
Ayrshire	13 29	33.71	31.58	32.14	31.04	31.39	33.00	30.16	28.06	24.93	23.45	18.90	19.40	31.10	19.10	5.00	......	......	......
Jersey	18.11	28 36	25.33	24.65	27.47	22.39	21.59	19.54	21.11	22.17	19.06	17.48	16 89	16.50	16.73	16.63	20.60	14 60	4.40
American Holderness	7.65	26.84	26.25	24 90	27.53	22.60	23.70	19.31	19.20	14.45	13 20	19.20	15.20	13.70	16 50	7.10	......	.....	......
Guernsey	11.25	26.87	28.00	25.50	26 83	27.97	27.45	26.55	25.55	22 70	22.15	24.75	23 60	17.10	......	......	......	......	......
Devon	9.95	21 95	21 20	20.30	18 40	17.40	15.25	17.75	16.60	20 50	.....	......	......	......	....	......	......	......	......
Average	12.34	30.50	29 35	27.70	28 52	25 92	27.85	25.37	24 26	22.47	21 43	23.65	22.22	22.30	18 83	14.26	24.70	22.75	4 40

AVERAGE ASH IN MILK BY BREEDS EACH MONTH OF LACTATION — POUNDS.

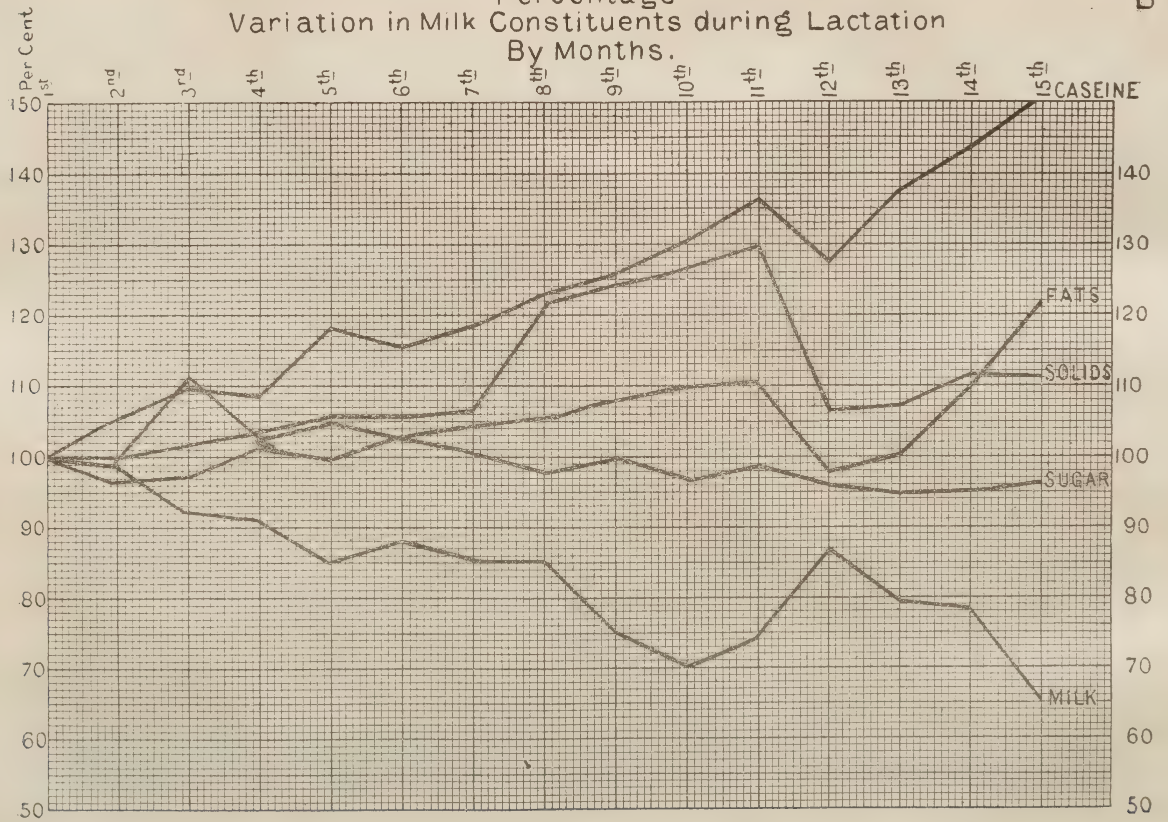
BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Holstein-Friesian	1.70	6.00	6.10	5.50	3.60	5.50	6.20	4.80	4.70	4.60	3.80	5.30	5.10	5.00	4.50	4.80	4.60	4.10	......
Ayrshire	1.70	4.42	4.10	3.92	3.92	4.00	4.20	4.00	3.58	3.25	2.80	2.50	2.75	4.40	2.80	0.70	......	......	......
Jersey	2.47	4.10	3.93	3.57	3.77	3.20	3.07	3.00	2.90	3.03	2.87	2.67	2.33	2.47	2.20	2.33	2.60	2.30	0.80
American Holderness	0.75	3.85	3.85	3.40	3.05	3.00	2.75	2.75	2.65	1.85	2.00	2.80	2.20	2.30	1.80	1.00	......	......	......
Guernsey	1.95	3.70	3.90	3.75	3.95	3.65	4.20	3.65	3.95	3.45	3.30	3.60	3.50	2.50	......	......	......	......	......
Devon	1.45	3.30	3.10	2.95	2.95	2.55	2.35	2.45	2.30	2.30	......	......	......	......	......	......	......	......	......
Average	1.67	4.23	4.16	3.85	3.54	3.65	3.80	3.44	3.35	3.08	2.95	3.37	3.18	3.33	2.82	2.21	3.60	3.20	0.80

General Average All Breeds each Month of Lactation. A

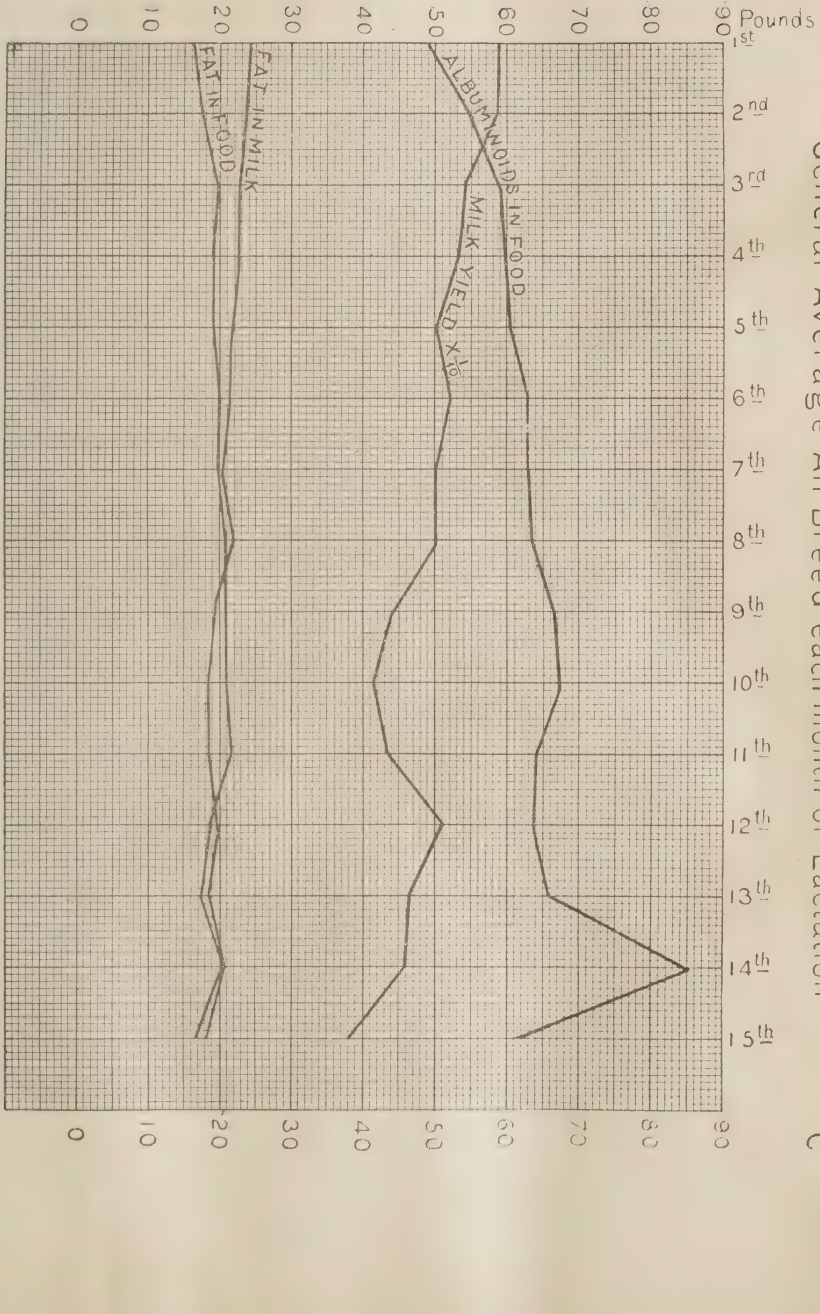


B

Percentage
Variation in Milk Constituents during Lactation
By Months.

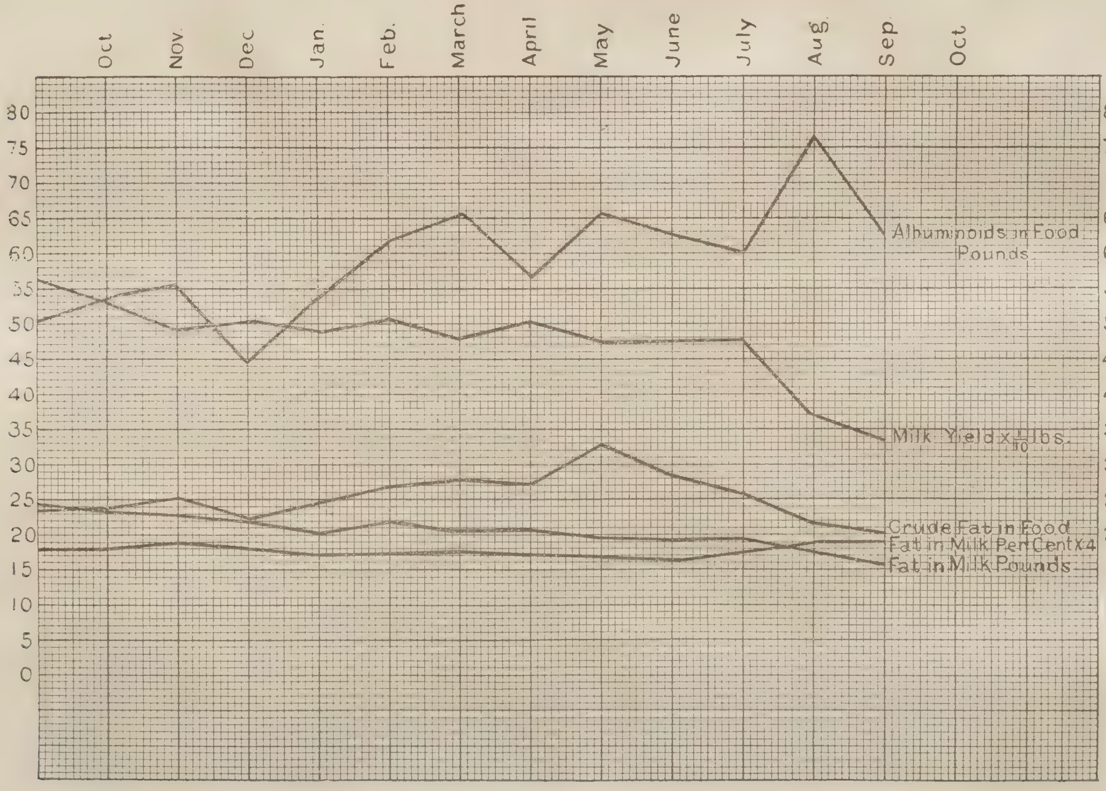


General Average All Breed each month of Lactation



C

Average Of All Animals each Month of the Year. D



The following table presents the general averages for all breeds during each month of lactation:

GENERAL AVERAGES OF ALL BREEDS EACH MONTH OF LACTATION.

	First.*	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.
Milk yield, pounds	245.00	587.30	586.70	547.90	538.70	503.30	510.40	471.20	470.40	418.60	416.50	442.90	439.00	437.60	386.20	293.10	470.90	401.10
Total solids, per cent....	14.09	13.13	13.04	13.36	13.56	13.90	14.08	14.00	14.17	14.41	14.20	14.55	14.32	14.50	14.40	15.20	14.90	15.81
Fats, per cent............	4.86	4.13	4.07	4.22	4.23	4.35	4.39	4.39	4.51	4.46	4.41	4.37	4.38	4.54	4.34	4.88	4.71	5.43
Caseine, per cent........	3.53	3.05	3.23	3.42	3.32	3.61	3.51	3.51	3.80	3.81	3.94	4.04	4.08	4.17	4.15	4.45	4.14	3.91
Sugar, per cent	5.00	5.20	5.01	5.06	5.29	5.24	5.42	5.35	5.13	5.39	5.10	5.29	5.10	5.02	5.16	5.10	5.28	5.63
Ash, per cent............	0.69	0.72	0.71	0.70	0.70	0.73	0.74	0.74	0.71	0.73	0.72	0.77	0.74	0.75	0.74	0.75	0.75	0.82
Total solids, pounds	34.73	76.68	75.96	72.61	72.38	69.09	70.48	65.33	66.21	60.41	59.05	62.98	61.42	61.96	54.32	42.28	68.30	59.00
Fats, pounds.............	12.20	24.08	23.78	22.65	22.59	21.49	21.43	20.21	20.84	18.73	18.31	18.65	18.29	18.57	16.42	15.05	20.70	18.10
Caseine, pounds.........	8.52	17.91	18.67	18.24	17.84	18.03	17.40	16.26	17.75	16.11	16.34	17.28	17.72	17.74	16.24	12.62	19.30	14.95
Sugar, pounds	12.34	30.50	29.35	27.70	28.52	25.92	27.85	25.37	24.26	22.47	21.43	23.65	22.22	22.30	18.83	14.26	24.70	22.75
Ash, pounds	1.67	4.23	4.16	3.85	3.54	3.65	3.80	3.44	3.35	3.08	2.95	3.37	3.18	3.33	2.82	2.21	3.60	3.20
Albuminoids in foods, pounds	16.24	48.75	54.78	58.38	59.40	59.40	60.39	61.97	63.10	66.15	66.86	65.73	66.88	63.75	77.28	69.00	75.40	79.53
Ash in foods, pounds....	9.50	26.30	27.20	30.10	30.40	30.50	29.90	29.20	29.50	31.40	30.60	31.60	30.90	29.30	35.40	28.10	32.60	34.60
Crude fiber in foods, pounds	44.10	109.00	106.40	120.00	118.60	122.60	115.30	114.20	114.70	119.30	118.50	120.40	111.60	104.80	123.60	124.40	128.20	124.00
Nitrogen free extract in foods, pounds	81.50	246.30	267.60	290.70	298.80	298.20	304.50	290.00	307.60	296.50	300.60	316.70	296.90	313.50	331.20	354.00	397.80	362.00
Crude fats in foods, pounds	7.30	22.10	23.50	26.20	25.40	25.40	25.80	25.60	26.30	26.30	27.30	28.10	24.80	23.80	24.00	21.40	25.60	24.20
Sugars and starch in foods, pound.	50.50	159.80	184.60	190.50	197.00	205.00	209.50	197.70	207.70	192.30	203.30	212.00	196.00	206.50	191.30	205.10	244.30	204.80

*First month is remainder after calving.

The following table presents the average percentage changes for all breeds in milk yield, the per cent and pounds of each milk and food constituent during each month of lactation:

MONTH OF LACTATION.	Quantity of milk	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.	Pounds crude fat.	Pounds albuminoids.	Pounds starch and sugar.	Pounds nitrogen free extract	Pounds crude fiber.	Pounds ash.
First	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Second	99.9	99.3	98.5	105.9	96.3	98.6	99.1	98.8	104.2	96.2	98.3	106.3	112.4	115.5	108.6	97.6	103.4
Third	93.3	101.7	102.2	112.1	97.3	98.6	94.7	94.1	101.8	90.8	91.0	118.6	119.8	119.1	118.0	110.1	114.4
Fourth	91.7	103.3	102.4	108.9	101.7	97.2	94.4	93.8	99.6	93.5	83.7	114.9	121.8	123.3	121.2	108.8	115.6
Fifth	85.7	105.9	105.3	118.4	100.8	101.4	90.1	89.2	100.7	85.0	86.3	114.9	121.8	128.3	121.1	112.5	116.0
Sixth	86.9	107.2	106.3	115.1	104.2	102.8	91.9	89.0	97.1	91.3	89.8	116.7	123.9	131.1	123.6	105.8	113.7
Seventh	80.2	106.6	106.3	115.1	102.9	102.8	85.2	83.9	90.8	83.2	81.3	115.8	127.1	123.7	117.7	104.8	111.0
Eighth	80.1	107.9	109.2	124.6	98.7	98.6	86.3	86.5	99.1	79.5	79.2	114.5	139.7	129.4	124.9	105.2	112.1
Ninth	71.3	109.7	108.0	124.9	103.7	101.4	78.8	77.8	89.9	73.6	72.8	114.5	135.7	120.3	120.4	109.4	119.4
Tenth	70.9	108.1	106.8	129.2	98.1	100.0	77.0	76.0	91.2	70.3	69.7	123.5	137.2	127.2	122.0	108.7	116.3
Eleventh	75.4	110.8	105.8	132.4	101.7	106.9	82.1	77.4	96.5	77.5	79.7	127.1	134.8	132.7	128.6	110.5	120.2
Twelfth	74.7	109.1	106.0	133.8	98.1	102.8	80.1	75.5	98.9	72.8	75.2	112.2	137.2	122.6	120.5	102.4	117.1
Thirteenth	74.5	110.4	109.9	136.7	96.5	104.2	80.8	77.1	99.1	73.1	78.7	107.7	130.8	129.2	127.3	96.2	111.4
Fourteenth	65.8	109.7	105.1	136.1	99.2	102.8	70.8	68.2	90.7	61.7	66.7	108.6	158.5	119.7	134.5	113.4	134.6
Fifteenth	50.0	115.8	118.2	145.9	98.1	104.2	55.1	62.5	70.5	46.8	52.2	96.8	141.5	128.3	143.7	114.1	106.8
Sixteenth	80.2	113.5	114.0	135.7	101.9	104.2	89.1	86.0	107.8	81.0	85.1	115.8	154.7	152.9	161.5	117.6	124.0
Seventeenth	68.3	120.4	131.5	128.2	108.3	113.9	76.9	75.2	83.5	74.6	75.6	109.5	163.1	128.2	146.9	113.8	131.6

The following table presents the average milk yield, fat in milk, crude fat and albuminoids in food, as also weight of the animals for each month in the year, and the diagrams A, B, C, D, graphically represent certain of the facts set forth in the preceding tables:

AVERAGES OF ALL ANIMALS FOR EACH MONTH OF THE YEAR.

	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.
Average milk yield, pounds	563.40	533.80	492.80	505.70	487.30	507.80	478.60	502.20	476.40	474.50	477.90	369.50	337.50
Average fat in milk, per cent	4.47	4.53	4.73	4.53	4.28	4.40	4.36	4.24	4.10	4.08	4.42	4.85	4.86
Average fat in milk, pounds	24.70	23.30	22.70	21.60	20.00	21.80	20.40	20.90	19.20	19.00	19.70	17.20	15.50
Average crude fat in food, pounds	23.70	23.00	25.10	21.90	24.20	26.80	27.60	26.90	32.80	28.30	25.70	21.60	20.00
Pure fat in food (75.3 per cent)	17.90	18.10	18.90	16.50	18.20	20.20	20.80	20.20	24.70	21.30	19.40	16.30	15.10
Average albuminoids in food, pounds	50.82	53.18	55.51	44.31	53.71	61.70	65.67	56.37	65.30	62.21	60.34	76.25	62.37
Average weight animals	850.00	864.00	870.00	842.00	836,00	822.00	814.00	822.00	829.00	843.00	834.00	889.00	893.00

The following tables give the cost of food in dollars for each animal for each month and day of lactation and the average cost per pound of milk and per pound of fat in milk*:

COST OF FOOD EACH MONTH OF LACTATION.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.
Hol.-Friesian ..	Esel 2d	1.00	5.24	5.67	5.83	5.06	5.81	5.73	5.12	5.09	5.48	5.44	5.25	5.20	4.50	5.11	5.87	5.87	6.11	......
Ayrshire........	Miss Flow 5th....	1.89	4.17	4.71	5.62	6 99	4.73	5.28	4.65	4.78	5.22	4.95	2.82	......	......	......	......	.....	......	......
Ayrshire	Queen Duchess..	.42	4.06	3.99	4.73	5.21	5.02	5.37	4.83	5.35	5.16	5.26	4.87	4.86	3.31	4.35	3.10	.32	......	......
Ayrshire........	Manton Belle....	1.82	3.37	4.27	5.01	4.85	4.60	4.32	4.43	4.24	4.39	4.82	4.50	1.87	......	......	......	......	......	......
Ayrshire........	Junietta Peerless	1.12	2.79	3.49	4.01	3.82	3.83	3.70	3.63	4.09	4.14	4.22	......	.....	......	......	......	.....	......	......
Jersey	Gilderbloom	2.08	4.52	4.84	4.49	4.63	4.55	4.47	3.64	3.83	3.63	3.82	3.79	3.47	3.80	3.66	3.85	....	......	......
Jersey	Countess Flavia.	1.05	4.49	6.26	4.61	5.19	4.93	4.77	5.38	5.05	5.23	4.46	5.09	4,52	4.48	3.84	3.88	3.78	3.14	2.55
Jersey	Barbara Allen...	.27	3.31	4.46	5.04	4.74	4.80	4.30	4.76	4.35	4.20	4.18	4.24	4.12	4.01	3.96	4.57	4.73	.....	......
Am. Holderness	Maggie 6th.......	.25	3.70	4.74	4.28	3.95	3.54	3.93	3.64	3.82	3.66	3.63	3.54	3.40	3.88	3.99	3.98	......	......	......
Am Holderness	Nellie 6th	1.01	3.73	4.57	3.73	3.90	3.45	3.46	3.35	3.36	1.25	2.58	2.50	2.36	......	......	......	....	......	......
Guernsey.......	Rosette Ford	1.41	3.83	4.60	4.16	4.61	4.85	4.53	4.18	3.20	4.12	4.03	4.57	4.55	3.73	......	......	......	......	......
Guernsey.......	Oriole	1.69	2.62	3.49	4.50	4.35	4 47	4.17	4.24	4.12	4.04	4 75	4.78	4.94	......	......	.....	......	......	......
Devon	Ione	1.59	3.26	3.91	3.76	3.89	3.76	3.70	3.20	4.26	4.29	......	......	......	......	....	......	......	......	......
Devon	Genevie's Gift...	.80	2.40	2.91	2.88	2.76	3.15	3.16	3.21	......	......	......	......	......	......	......	......	......	......	......

* Remainder of month after calving.

COST OF FOOD EACH MONTH OF LACTATION — (*Concluded*).

Breed.	NAME OF ANIMAL.	Total cost.	Number of days.	Average cost per day.	Total milk yield.	Total fat yield.	Average cost of milk.	Average cost of fat.
				Cents.	Pounds.	Pounds.	Cents.	Cents.
Holstein-Friesian	Esel 2d	$93.98	534	17.60	11,918	424.5	.788	22.1
Ayrshire	Miss Flow 5th	55.81	361	15.46	5,251	200.5	1.063	29.3
Ayrshire	Queen Duchess	69.89	465	15.03	9,489	425.8	.737	16.4
Ayrshire	Manton Belle	52.49	376	13 96	6,796	230.4	.772	22.7
Ayrshire	Junietta Peerless	38.84	330	11.77	4,792	139.9	.811	27.7
Jersey	Gilderbloom	63.07	479	13.17	5,118	285.7	1.232	22.1
Jersey	Countess Flavia	82.70	561	14.74	8,024	477.1	1.031	17.3
Jersey	Barbara Allen	70.04	490	14.30	6,950	476.4	1.078	14.7
American Holderness	Maggie 6th	57.93	463	12.51	6,182	220.2	.937	26 6
American Holderness	Nellie 6th	39.25	322	12.19	4,095	142.8	.958	27.5
Guernsey	Rosette Ford	56.37	413	13.65	6,110	307.8	.923	18.3
Guernsey	Oriole	52.16	390	13.37	6,627	335.9	.787	15.5
Devon	Ione	35.62	300	11.87	3,541	162.6	1.006	21.9
Devon	Genevie's Gift	21.27	231	9.21	2,191	108.2	.971	19.7
	Average	....	....	13.49	....	....	.935	21.6

The following table presents the relative cost of production of milk, and of fat in milk, for each animal, and for the several breeds:

RELATIVE COST OF PRODUCTION OF MILK AND FAT.

Milk.	Ratio.	Fat.	Ratio.
Queen Duchess	100	Barbara Allen	100
Manton Belle	105	Oriole	106
Oriole	107	Queen Duchess	112
Esel 2d	107	Countess Flavia	118
Junietta Peerless	110	Rosette Ford	124
Rosette Ford	125	Genevie's Gift	134
Maggie 6th	127	Ione	149
Nellie 6th	130	Gilderbloom	150
Genevie's Gift	132	Esel 2d	150
Ione	137	Manton Belle	154
Countess Flavia	140	Maggie 6th	181
Miss Flow 5th	144	Nellie 6th	187
Barbara Allen	146	Junietta Peerless	188
Gilderbloom	167	Miss Flow 5th	199

RELATIVE COST BY BREEDS.

Holstein-Friesian	100	Guernseys	100
Ayrshires	107	Jerseys	107
Guernseys	108	Devons	124
American Holderness	121	Holstein-Friesian	130
Devons	126	Ayrshires	160
Jerseys	141	American Holderness	160

By reference to the table (page 110) which gives the relative cost of production of milk and of milk fat (which is practically the same relation for production of butter) of the several animals and breeds, it is obvious that the dairyman should first decide whether he desires to produce milk or butter from his herd since, as will be seen from the tables, these cows, cared for alike and fed the same foods, differed widely in relative value for production of milk and milk fat, the relative cost in production of milk varying in individuals from 100 to 167 and in breeds from 100 to 141; while in the production of milk fat they varied in individuals from 100 to 199, and in breeds from 100 to 160.

It will be seen also that in individual cases we find certain cows standing high in the list for the economical production of both milk and butter, while there are also certain ones which are relatively poor for both milk and butter, but these are exceptional cases, since as a rule the Guernseys and Jerseys are noticeable for their low cost in butter production, while the Holstein-Friesians, Ayrshires and Guernseys are characterized by their relatively low cost of milk production. The Devons and American Holderness stand more nearly midway between these other breeds. The dairyman needs therefore to select the breed best suited to his purpose, and also to thoroughly test the relative value of the individuals in his herd of whatever breed or grade. These two points may be regarded as of prime importance.

In the table (page 109) which gives the daily cost of the food fed these animals there has been no allowance made for the fertilizing value of the manure secured, which if carefully husbanded would equal fully seventy per cent of the market value of the food, and thus reducing this daily ration, the market value of which averaged, as will be seen, 13 49 cents to only 4.05 cents per animal per day.

It will be seen from the table (page 40) that these animals received as a part of their ration grain every day, and while the cost of food was low the animals have thrived and been maintained in good condition, their average weight having increased, as is seen in table on page 107, from 850 pounds to 893 pounds in twelve months.

The average weight of the cows for a year was 816 pounds, and the average daily amount of dry matter in their food was 17.34 pounds, or for 1,000 pounds weight 21.2 pounds.

The following table gives for seven cows the average yield of milk as also of milk fat, and the pounds of albuminoids and crude fat present in the foods fed during November and December. The rest of the herd had ceased giving milk or were so nearly dry that they were excluded.

These results are highly interesting as showing a change in milk production in cows averaging a year in lactation.

We find here a reverse in the average results since we have:

1. An increase in mild yield of 5.5 per cent.
2. An increase in the milk fat produced of 2.4 per cent.
3. A decrease in the per cent of fat in the milk of 3.1 per cent.

By reference to table on page 77, we shall see that as an average we found between the twelfth and thirteenth months of lactation:

1. A decrease in milk yield with eight cows of twelve per cent.
2. A decrease in fat produced of 5.5 per cent.
3. An increase in per cent of fat in milk of 1.7 per cent.

We observe that there was an increase of albuminoids in the food of December of 7.6 per cent over the amount in November, and an increase of the amount of crude fat in the food of 8.4 per cent.

The change in the quality of the food was an increase of fifty per cent in the amount of ensilage, and a decrease of one-third in the amount of hay fed, also the substitution during December of cotton-seed meal for corn meal in the grain mixture.

The nutritive ratio for November was 1. to 5.8 and for December one to 5.2.

MONTHS OF LACTATION.		November — Milk yield.	December — Milk yield.	November — Fat in milk.	December — Fa in milk.	November — Fat in milk.	December — Fa in milk.	November — Al-buminoids n food.	December — Al-buminoids in food.	November — Fat in food.	December — Fa in food.
		Pounds.	Pounds.	Per cent.	Per cent.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
17th and 18th ...	Esel 2d	563.8	540.3	3.11	2.80	17.5	15.1	85.3	92.9	27.1	29.8
10th and 11th ...	Junietta Peerless	410.1	434.9	2.91	2.93	11.9	12.7	62.6	64.4	19.3	20.6
15th and 16th ...	Gilderbloom	155.9	164.3	5.87	6.45	9.2	10.6	52.9	58.6	17.1	19.0
15th and 16th ...	Barbara Allen	340.7	361.9	6.16	6.27	21.0	22.7	66.3	71.9	21.2	23.1
12th and 13th ...	Oriole	495.5	538.4	5.24	5.21	26.0	28.1	69.1	75.1	22.1	24.1
9th and 10th ...	Ione	311.9	328.8	5.31	4.66	16.6	15.3	62.3	65.3	20.1	21.1
7th and 8th ...	Genevie's Gift	243.2	291.7	6.31	5.51	15.4	16.1	46.6	49.0	15.1	16.1
12th and 13th ...	Average.	360.2	380.0	4.99	4.83	16.8	17.2	63.4	68.2	20.3	22.0
	Ratio	100	105.5	100	96.9	100	102.4	100	107.6	100	108.4

The following table gives the amount of food fed and its leading constituents, as also the milk yield and the amount of milk fat produced during five months, which averaged for the thirteen animals under this experiment, the eighth to the twelfth, both inclusive, of lactation, during which period the changes in the proximate composition of the food was most marked.

The percentage of changes in the albuminoids, sugar and starch and the crude fat in the food, as also in the milk yield and milk fat produced during this period of five months are as follows:

	Albuminoids not amides, in food.	Sugars and starch in food.	Crude fat in food.	Milk yield. Pounds.	Per cent fat in milk.	Pounds fat in milk.
June....................	100	100	100	100	100	100
July....................	94	115	85	100	99	99
August.................	91	123	77	92	106	97
September.............	115	88	65	74	117	86
October.	95	110	61	68	117	77

The above average as also the details of the table which follows is of much interest in connection with the question as to the function of the several food constituents in the animal economy.

It will be seen that while the albuminoids in the food was increased nearly twenty-seven per cent the milk yield diminished twenty per cent, while the milk fat diminished but twelve per cent.

In the detailed table as an average 78.93 pounds of albuminoids were fed during September, the average milk yield during the same month being 375.7 pounds, while during the previous month 62.26 pounds of albuminoids were fed and the milk yield was 467.5 pounds; this is a falling off in the milk yield of about twenty-per cent, while as we see upon page 77 the average falling off in milk between the tenth and eleventh month of lactation was upon an average 430.6 pounds to 402.2 pounds or 6.6 per cent.

Again between September and October the average amount of albuminoids fed dropped from 78.93 pounds to 64.67 pounds or about eighteen per cent, while the average milk yield dropped from 375.7 pounds to 344.8 pounds, or eight per cent, but by the table, page 77, we see that the average falling off in milk yield between the twelfth and thirteenth month of lactation was less than five per cent, so that the large reduction of eighteen per cent in albuminoids fed did not diminish the milk yield over three per cent.

RELATION OF MILK YIELD AND COMPOSITION TO CERTAIN FOOD CONSTITUENTS.

June was month of lactation.	NAME OF ANIMAL.	JUNE.						JULY.						AUGUST.					
		Milk yield, pounds.	Albuminoids in food, pounds.	Fat in food, pounds.	Sugar and starch in food, pounds.	Fat in milk, per cent.	Fat in milk, pounds.	Milk yield, pounds.	Albuminoids in food, pounds.	Fat in food, pounds.	Sugar and starch in food, pounds.	Fat in milk, per cent.	Fat in milk, pounds.	Milk yield, pounds.	Albuminoids in food, pounds.	Fat in food, pounds.	Sugar and starch in food.	Fat in milk, per cent.	Fat in milk, pounds.
Twelfth..........	Esel 2d..................	683 0	87.62	42.9	237.3	3.20	21.9	741.6	79.75	35.8	257.8	2.99	22.2	662.0	77.69	32.2	273.6	2.92	19.3
Twelfth..........	Queen Duchess.... ..	680.9	82.62	41.2	222.7	3.60	24.5	673.5	75.25	34.1	249.9	3.72	25.1	588.0	71 37	29.8	252.5	4.13	23.0
Seventh..........	Manton Belle	652.1	75.06	38.2	197.1	3.36	21.9	657.3	69.75	32.0	224.2	3.22	21.2	588.7	66.31	28.2	238.7	3.42	20.1
Fourth...........	Miss Flow 5th.........	591.6	69.25	34.5	184.7	3.17	19.2	534.4	65.37	29.7	212.2	3.20	18.1	551.7	64 62	27.3	230.9	3.47	18.5
Fifth.............	Junietta Peerless.....	487.0	66.25	33.1	174.8	2.78	13.5	488.9	60.75	27.8	193.3	2.72	13.3	486.1	57.62	25.0	209.4	2.91	14.1
Tenth............	Gilderbloom	315.5	62.25	30.8	166.0	5.60	17.7	301.0	59.94	27.4	199.9	4.91	14.8	255.5	59.37	25.5	215.9	4.97	12.7
Fifteenth	Countess Flavia	406.2	65.69	33.0	174.9	5.87	23.8	408.1	60.81	27.8	198 3	5.89	24.0	377.9	59.19	25.4	215.3	6.32	23.9
Eleventh.........	Barbara Allen	468.3	70.44	34.9	190.2	4.89	22.9	471.7	65.69	29.7	217.9	5.15	24.3	444.0	64.37	27.2	229.9	5.52	24.5
Tenth............	Maggie 6th............	407.6	59.94	29.6	162.0	3.87	15.8	416.9	56.37	25.5	183.9	3.31	13.8	391.8	55.44	23.4	198.0	3.45	13.5
Eighth...........	Rosette Ford..........	476.1	70.25	34.8	189.9	4.76	22.7	463.7	65.69	29.8	214.2	4.74	22.0	452.0	64.37	27.1	229.8	4.98	22.5
Seventh..........	Oriole..................	558.2	70.00	34.7	189.5	4.85	27.1	577.9	65.69	29.7	214.2	4.95	28.6	560.6	64.44	27.2	229.9	5.22	29.3
Fourth...........	Ione	471.3	64 81	32.3	171.9	3.90	18.4	460.4	63.00	27.9	198.7	3.93	18.1	392.4	59.12	25.4	214.2	4.54	17.8
Second...........	Genevie's Gift	403.7	45.62	24.2	111.9	3.38	13.7	383.1	45.37	22.1	153.1	4.00	15.3	326.3	45.50	20.2	170.6	4.69	15.3
	Average	507.8	68 45	34.2	182.5	4.09	20.2	506.0	64.11	29.1	209.0	4.06	20.1	467.5	62.26	26.4	223.7	4.34	19.6

RELATION OF MILK YIELD AND COMPOSITION TO CERTAIN FOOD CONSTITUENTS.

June was month of lactation.	NAME OF ANIMAL.	SEPTEMBER.						OCTOBER.					
		Milk yield, pounds.	Albuminoids in food, pounds.	Fat in food, pounds.	Sugar and starch in food, pounds.	Fat in milk, per cent.	Fat in milk, pounds.	Milk yield, pounds.	Albuminoids in food, pounds.	Fat in food, pounds.	Sugar and starch in food.	Fat in milk, per cent.	Fat in milk, pounds.
Twelfth	Esel 2d	612.9	102.00	29.1	213.6	3.87	23.7	617.2	89.81	28.2	287.4	3.30	20.4
Twelfth	Queen Duchess	363.3	88.81	25.1	180.9	3.95	14.4	122.4	56.50	15.7	150.1	5.30	6.5
Seventh	Manton Belle	464.7	89.50	25.3	182.6	3.75	17.4	385.0	75.56	23.7	235.5	3.83	14.7
Fourth	Miss Flow 5th	449.5	83.12	23.6	170.8	3.90	17.6	431.5	......	22.0	......	3.76	17.1
Fifth	Junietta Peerless	427.1	74.06	21.0	152.0	3.12	13.3	435.8	63.06	19.9	201.6	3.09	13.5
Tenth	Gilderbloom	204.5	71.44	20.3	145.9	5.41	11.0	182.2	58.25	18.5	192.0	6.22	11.3
Fifteenth	Countess Flavia	261.9	66,12	18.6	132.4	8.07	21.1	87.0	46.69	18.5	80.2	6.30	5.5
Eleventh	Barbara Allen	337.1	81.25	23.1	167.9	5.58	18.8	367.4	69.00	21.9	224,3	5.41	19.9
Tenth	Maggie 6th	318.2	69.25	19.7	142.6	3.78	12.0	320.1	59.44	18.8	193.8	3.71	11.9
Eighth	Rosette Ford	380.4	81.81	23.2	168.7	5.71	21.7	386.9	70.12	22.2	228.0	5.93	22.9
Seventh	Oriole	475.3	81.50	23.2	169.1	5.30	25.2	521.8	72.50	22.9	236.0	5.65	29.5
Fourth	Ione	323.5	77.31	21.7	154.5	4.67	15.1	346.0	65.31	20.9	212.7	4.45	15.4
Second	Genevie's Gift	265.2	59.87	16.6	116.2	4.95	13.1	277.9	49.81	16.0	161.7	5.09	14.1
	Average	375.7	78.93	22.3	161.3	4.77	17.3	344.8	64.67	20.7	200.3	4.77	15.6

With a view to the further elucidation of this question, the following table presents the results obtained from each of the animals under investigation during the entire period of lactation of most of them, and the relation between certain constituents of their food and certain of the milk constituents.

It will be seen that the amount of albuminoids present in the food was 264 per cent greater than the caseine of the milk, a result which closely agrees with previous results secured at the Station, since, as the average of these results, we find that 27.5 per cent of the albuminoids of the food were utilized in milk production, while, in a previous experiment with five cows, it was found that the caseine of the milk produced by them was equal to 26.5 per cent of the albuminoids present in the food consumed by them.

It will be seen that the excess of albuminoids consumed over and above the caseine found in the milk was almost exactly double (198 per cent) the amount of the fat produced in the milk; also that the crude fat (ether extract) present in the food was 17 per cent greater than the fat present in the milk.

It is obviously of very great practical importance to determine if possible the source of the fat present in the milk, and the data already presented is valuable as throwing some light upon this as yet unsettled problem.

Dr. Foster, the eminent physiologist of Cambridge, England, in the latest edition of his Physiology, says, on page 785, that "the quantity of fat present in milk is largely and directly increased by proteid, but not increased, on the contrary diminished, by fatty food"; and upon page 773 he quotes approvingly that "Liebig showed that the butter (fat?) present in the milk of a cow was much greater than could be accounted for by the scanty fat present in the grass or other fodder she consumed."

Now we have shown in the table, page 115, that the average of thirteen cows gave a consumption of 62.3 pounds of albuminoids and of 26.4 pounds of crude fat, with a production in the milk of 19.6 pounds of fat, during the month of August; while in September they consumed upon an average 78.9 pounds of albuminoids and 22.3 pounds of crude fat, with a production of but 17.3 pounds of milk fat; or an increase of 15.5 per cent in the fats consumed resulted in a decreased production of milk fat amounting to 11.7 per cent — results diametrically opposed at every point to the statement of Dr. Foster above quoted. And again, in July, the albuminoids fed were somewhat less than in June (6.3 per cent), while the amount of fat in the food was 14.9 per cent less in July than in June; but, as will be seen, the decrease of albuminoids did not decrease the production of fat in the milk, nor did the decrease of fat in the food increase the fat in the milk, since in July it was within .5 per cent of what it was in June.

The following table presents in another form certain of the results given in the preceding table :

RELATION OF MILK YIELD AND COMPOSITION TO CERTAIN FOOD CONSTITUENTS.

Months in lactation.	NAME OF ANIMAL.	Pounds of milk yield.	Pounds of fat in milk.	Pounds of caseine in milk.	Pounds crude fat in food.	Pounds albuminoids not amides in food.	Pounds crude fat in food to one lb. milk.	Pounds albuminoids in food to one lb. milk.	Pounds crude fat in food to one lb. fat in milk.	Pounds albuminoids in food to one lb. fat in milk.
Eighteen	Esel 2d	11,918	424.5	380.4	538.9	1,268.0	.045	.106	1.27	2.99
Twelve	Miss Flow 5th	5,251	200.5	189 6	272.4	729.7	.052	.139	1.36	3.64
Seventeen	Queen Duchess	9,489	425.8	324.6	423.3	943.9	.045	.099	.99	2.22
Thirteen	Manton Belle	6,796	230.4	212.8	332.9	724.8	.049	.107	1.44	3.14
Eleven	Junietta Peerless	4,792	139.9	138.6	243.5	547.0	.051	.114	1.74	3.91
Sixteen	Gilderbloom	5,118	285.7	187.9	360.0	809.9	.070	.158	1.26	2.83
Nineteen	Countess Flavia	8,024	477.1	331.5	473.8	1,171.8	.059	.146	.99	2.46
Seventeen	Barbara Allen	6,950	476.4	243.3	402.9	911.6	.058	.131	.85	1.91
Sixteen	Maggie 6th	6,182	220.2	197.7	338.9	763.0	.055	.123	1.10	3.47
Thirteen	Nellie 6th	4,095	142.8	133.3	201.3	623.0	.049	.152	1.41	4.36
Fourteen	Rosette Ford	6,110	307.8	207.6	338.6	767.3	.055	.126	1.10	2.49
Thirteen	Oriole	6,627	335.9	212.7	317.2	706.4	.048	.107	.94	2.10
Ten	Ione	3,541	162.6	129.2	225.8	514.3	.064	.145	1.39	3.16
Eight	Genevie's Gift	2,191	108.2	74.1	136.9	302.7	.064	.138	1.26	2.80
Average	Average	6,220	281.3	211.7	329.0	770.2	.053	.124	1.17	2.74

REGULARITY OF MILK SECRETION.

In the ninth annual report it was shown for the cow Flora that the average for fifteen days showed that during the night there was an hourly secretion of 11.238 ounces, and during the day of 11.246 ounces of milk, proving conclusively that for this particular cow there was a uniform rate of milk secretion during night and day, and that this uniformity was not disturbed by frequent and decided changes in the times of milking. On the other hand with the cow Ann during a period of fifty-eight days, the amount of milk secreted per hour during the night was to that secreted per hour during the day, as 100 to 98.8, and it is interesting to compare these results already recorded with the cow Flora, since it shows the danger of drawing conclusions from results secured from the individual, however carefully ascertained.

During four days several cows, consisting of two Holsteins, three Jerseys, two Ayrshires, one Guernsey and one American Holderness, were milked regularly at intervals of twelve hours each, or as near that as was practicable, the exact time in each case being recorded. There were slight differences in the yield per hour, but not uniform for either animal, and the average results from these nine cows, of five different breeds, showed that the amount, by weight, of milk secreted from 5 P. M. to 5 A. M. was the same as that secreted from 5 A. M. to 5 P. M. during these four days of trial, as will be seen by the following table giving the average results for each day:

AVERAGE POUNDS MILK PER HOUR.

	Nov. 22.	Nov. 23.	Nov. 24.	Nov. 25.	Average.
During night.........	.674	.690	.720	.701	.696
During day	.691	.710	.705	.693	.700

This is a difference of only six-tenths of one per cent more during the day.

The following table presents the average yield and composition of the morning's and evening's milk of each one of fifteen cows of six different breeds, and the general average of all. There were made in all 465 analyses each of morning's and evening's milk, so that these results may be regarded as conclusive; but it is quite possible and even probable that far different results might follow with animals which, from one cause or another, were subjected to other conditions which might tend to disturb the exercise of so important a function as the secretion of milk, which, as has been shown, appears normally to proceed with surprising regularity.

The yield of milk showed a slight excess in the evening's milk over the morning's, or as 100 to 100.6, and this is so slight that an average difference of two and one-fifth minutes in the time of milking might have caused it, but that the evening's milk also contained a little more water than the morning's milk. The rations of the several solid constituents being as follows:

	Morning's milk.	Evening's milk.
Total solids	100	98.98
Fat	100	99.06
Caseine	100	98.34
Sugar	100	99.42
Ash	100	97.56

NAME OF ANIMAL.	Number of analyses.	MORNING.									EVENING.								
		Total solids.	Solids not fat.	Water.	Fat.	Caseine.	Sugar.	Ash.	Nitrogen.	Milk yield, pounds.	Total solids.	Solids not fat.	Water.	Fat.	Caseine.	Sugar.	Ash.	Nitrogen.	Milk yield, pounds.
Tolsma Artis	28	11.78	8.52	88.25	3.27	3.37	4.49	0.72	0.51	11.1	11.96	8.66	88.06	3.30	3.28	4.62	0.74	0.52	10.5
Esel 2d	38	13.05	9.37	86.95	3.68	3.54	5.11	0.75	0.56	12.0	12.78	9.73	87.21	3.58	3.36	5.13	0.73	0.53	11.7
Miss Flow 5th	41	14.02	9.69	85.98	4.33	3.74	5.22	0.73	0.59	8.2	13.84	9.51	86.16	4.30	3.70	5.11	0.71	0.59	7.8
Queen Duchess	34	13.55	9.76	86.45	3.78	3.52	5.48	0.75	0.56	10.6	13.42	9.06	86.61	3.30	3.42	5.79	0.69	0.54	12.6
Manton Belle	28	12.58	9.05	87.42	3.53	3.31	5.07	0.67	0.52	9.7	12.49	9.06	87.51	3.43	3.11	5.31	0.63	0.49	9.7
Junietta Peerless	23	12.41	9.42	87.59	2.98	3.32	5.40	0.70	0.53	7.5	12.15	9.27	87.85	2.88	3.28	5.29	0.70	0.52	7.5
Gilderbloom	35	15.29	9.78	84.71	5.56	3.88	5.10	0.75	0.61	6.0	15.19	9.56	84.81	5.63	3.79	5.03	0.74	0.60	6.0
Countess Flavia	49	15.99	10.25	84.01	5.74	4.12	5.36	0.77	0.65	7.9	16.08	10.04	83.92	6.05	4.15	5.13	0.76	0.66	7.8
Barbara Allen	35	14.93	9.72	85.07	5.22	3.79	5.20	0.72	0.60	7.3	14.90	9.47	85.10	5.43	3.71	5.08	0.72	0.59	7.5
Maggie 6th	34	12.75	9.07	87.25	3.68	3.40	4.98	0.72	0.54	7.2	12.42	8.90	87.58	3.52	3.30	4.94	0.67	0.52	7.3
Nellie 6th	28	12.68	9.19	87.32	3.49	3.41	5.07	0.71	0.54	6.2	12.66	9.14	87.34	3.52	3.44	5.05	0.69	0.54	6.1
Rosette Ford	28	14.90	9.70	85.10	5.21	3.69	5.25	0.74	0.58	7.5	14.59	9.47	85.41	5.08	3.67	5.10	0.74	0.58	7.8
Oriole	28	14.62	9.40	85.31	5.22	3.55	5.07	0.78	0.56	8.4	14.28	9.30	85.72	4.98	3.52	5.02	0.75	0.56	8.3
Ione	20	14.09	9.83	86.00	4.23	3.90	5.12	0.80	0.62	6.9	13.82	9.63	86.18	4.19	3.88	4.94	0.76	0.61	6.7
Genevie's Gift	16	13.59	9.56	86.41	4.02	3.65	5.18	0.73	0.58	5.9	13.56	9.39	86.44	4.17	3.60	5.04	0.75	0.57	5.8
Average	465	13.75	9.49	86.25	4.26	3.61	5.14	0.737	0.570	8.16	13.61	9.35	86.39	4.22	3.55	5.11	0.719	0.561	8.21

THE SOURCE OF FAT IN MILK.

We have already referred to the statement of Liebig that it was manifestly impossible that the scanty amount of fat in grass and fodder could account for the fat present in the milk of the cow, but as to the statement it would be far more readily accepted if the figures were given which prove it. It may be seriously questioned whether any cow fed entirely upon grass or any other green fodder will for months continue to produce more fat in her milk than careful analysis will show to be present in such grass or fodder.

With a view to determine, if possible, this important question interesting to the physiologist and of great practical value to the dairymen the following table has been compiled from the data, secured in the investigations of our cattle, which gives for each month of lactation for each animal the number of pounds of crude fat consumed in the food and the number of pounds of fat produced in the milk, and a study of the table will show results of much interest as bearing upon this question.

The aggregate number of pounds of crude fat and of milk fat is given under each column, and under the aggregates of the crude fat are given the several percentages which these pounds of crude fats represent as compared with the pounds of milk fats.

The agregate number of pounds of crude fat consumed by these animals was 4,587.9 and the aggregate amount of milk fat produced by them was 3,793.4 pounds; or as 121 to 100. If we allow upon an average 17.4 per cent of the crude fat as impurity, it would still leave fat enough in the food to account for all recovered in the milk.

Upon the right hand of the table are given the averages of each animal for each month of lactation, and it is interesting to observe that during the earlier months the production of fat in milk is considerably in excess of even the crude fat of the food, but very soon the amount of crude fat eaten, and the amount produced became equal, and by a rather steady increase relatively the amount of crude fat consumed becomes at later months of lactation, largely in excess of the fat produced in the milk.

Such a result appears to be in accord with common observation, since, as is well known, the cow and other animals, as the time of giving birth to their offspring approaches, often becomes dangerously laden with the accumulation of fat stored up in their bodies, and it is also a matter of common remark that soon after the period of lactation begins with the cow, this stored up fat, which seems like a provision of nature to enable her to meet such emergency, disappears, only to reappear again when a like emergency is to arise in the near future.

WHAT IS CRUDE FAT?

In the tables, as one of the constituents of the foods, crude fat is mentioned and its amount determined. By crude fat is meant in this report that portion of the food, whether hay or ensilage, grain or roots, which is dissolved out by ether; and it is well known that in all foods there are present besides the oils and fats several other compounds in greater or less quantities, according to the food under examination, which compounds resemble the fats and oils in being soluble in ether. The character of this ether extract, as the mixture of these several compounds soluble in ether is termed, has recently been studied by others, and is at present being investigated at this Station.

Dr. August Stellwaag has by the method of saponification studied the composition of the ether extract of several foods, and finds these extracts to contain of fats and fat acids the following per cents :

	Neutral fats.	Fat acids.	Total.
Hay	23.73	37.32	61.05
Rye bran	78.31	18.77	97.08
Wheat bran	78.73	15.82	94.55
Barley	72.99	16.99	89.98
Oats	61.60	29.58	91.18
Corn	88.71	6.67	95.38
Peas	58.57	30.50	89.07
Beans	57.70	24.80	82.50
Malt sprouts	24.60	32.65	57.25
Linseed cake	89.56	8.86	98.42
Palm-nut cake	83.79	13.39	97.18
Cotton-seed cake	81.14	6.30	78.44
Potatoes	16.33	59.07	75.40
Beets	23.04	35.34	58.38

POUNDS OF CRUDE FAT IN FOOD AND FAT IN MILK DURING MONTHS OF LACTATION.

MONTH OF LACTATION.	ESEL 2D.		QUEEN DUCHESS.		MISS FLOW 5TH.		MANTON BELLE.		JUNIETTA PEERLESS.		GILDERBLOOM.		COUNTESS FLAVIA.		BARBARA ALLEN.	
	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.
First	13.3	8.4	4.0	3.3	20.4	9.3	13.1	12.8	5.9	7.2	20.7	10.8	9.0	4.7	25.5	17.5
Second	32.2	29.0	35.1	22.5	24.8	22.9	20.1	20.1	13.5	19.0	30.1	23.1	30.3	25.6	25.3	22.9
Third	34.6	28.5	30.1	20.5	22.4	21.8	18.5	25.6	13.6	23.7	24.6	21.3	32.7	28.5	26.3	22.6
Fourth	28.4	30.3	27.4	25.1	23.5	31.1	25.9	30.3	14.7	26.9	25.3	23.5	31.1	26.0	25.0	25.1
Fifth	27.5	27.8	26.0	23.8	22.0	31.6	23.4	32.3	13.5	33.1	23.4	22.9	30.8	27.4	28.2	23.9
Sixth	28.4	29.9	26.6	27.3	22.3	28.0	21.8	31.1	13.3	27.8	18.4	24.0	30.1	24.6	22.5	25.0
Seventh	28.1	27.3	26.9	26.5	19.6	28.5	21.9	38.2	14.1	25.0	19.4	26.4	28.5	25.3	23.6	28.5
Eighth	24.5	29.1	21.5	27.9	18.7	23.5	21.2	32.0	13.3	21.0	17.3	24.0	28.4	24.0	22.8	28.1
Ninth	25.0	33.1	27.1	31.7	16.5	25.0	20.1	28.2	13.5	19.9	19.2	25.4	27.8	25.9	23.1	28.2
Tenth	21.5	35.3	24.6	33.7	8.4	23.8	17.4	25.3	11.9	19.3	17.7	30.8	29.0	25.6	22.9	34.9
Eleventh	20.9	35.2	25.3	35.1	1.9	26.9	14.7	23.7	12.7	20.6	14.8	27.4	23.2	25.3	24.3	29.7
Twelfth	21.9	42.9	24.5	41.2	......	......	9.5	20.9	......	......	12.7	25.5	27.3	29.7	24.5	27.2
Thirteenth	22.2	35.8	25.1	34.1	......	......	2.8	12.4	......	......	11.0	20.3	25.8	29.4	18.8	23.1
Fourteenth	19.3	32.2	23.0	29.8	......	......	......	......	......	......	11.3	18.5	24.8	28.5	19.9	21.9
Fifteenth	23.7	29.1	14.4	25.1	......	......	......	......	......	......	9.2	17.1	23.8	33.0	21.0	21.2
Sixteenth	20.4	28.2	6.5	15.7	......	......	......	......	......	......	10.6	19.0	24.0	27.8	22.7	23.1
Seventeenth	17.5	27.1	......	......	......	......	......	......	......	......	......	......	23.9	25.4	......	......
Eighteenth	15.1	29.8	......	......	......	......	......	......	......	......	......	......	21.1	18.1	......	......
	424.5	538.9	368.1	423.3	200.5	272.4	230.4	332.9	140.0	243.5	295.7	360.0	470.6	455.3	376.4	402.9
	......	126.9	......	115.0	......	135.9	......	144.5	......	171.8	......	121.7	......	96.7	......	107.0

POUNDS OF CRUDE FAT IN FOOD AND FAT IN MILK DURING MONTHS OF LACTATION—(*Concluded*).

MONTH OF LACTATION.	NELLIE 6TH.		MAGGIE 6TH.		ROSETTE FORD.		ORIOLE.		IONE.		GENEVIE'S GIFT.		AVERAGES FOR ALL.		RATIO.	
	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.	Milk.	Food.
First	11.5	6.4	3.2	2.2	10.6	6.9	21.0	11.6	9.8	9.7	5.2	6.6	12.3	8.4	100	68.3
Second	18.2	18.8	20.9	19.5	28.8	21.1	21.7	16.3	17.5	20.5	13.7	24.2	23.7	21.8	100	92.0
Third	17.8	20.2	19.7	20.7	26.6	20.2	20.1	21.0	18.6	26.2	15.3	22.1	22.9	23.1	100	100.9
Fourth	14.8	20.3	19.0	25.7	23.6	24.0	23.9	26.6	18.4	32.3	15.3	20.2	22.6	26.2	100	116.0
Fifth	15.7	19.1	16.6	19.5	25.7	27.2	27.3	28.1	18.1	27.9	13.1	16.6	22.2	25.8	100	116.2
Sixth	14.6	19.8	13.2	20.5	24.1	32.4	28.1	29.7	17.8	25.4	14.1	16.0	21.1	26.6	100	126.1
Seventh	13.2	19.6	15.3	23.2	24.8	30.1	27.1	34.7	15.1	21.7	15.4	15.1	21.0	26.5	100	126.2
Eighth	12.8	20.9	14.4	23.3	22.7	34.8	28.6	29.7	15.4	20.9	16.1	16.1	19.8	25.4	100	128.3
Ninth	13.8	21.3	15.5	25.2	22.0	29.8	29.3	27.2	16.6	20.1	......	......	20.8	26.2	100	126.0
Tenth	6.0	16.1	15.8	29.6	22.5	27.1	25.2	23.2	15.3	21.1	......	......	19.1	26.5	100	138.7
Eleventh	4.4	18.8	13.8	25.5	21.7	23.2	29.5	22.9	......	......	......	......	17.3	26.2	100	151.4
Twelfth	......	......	13.5	28.4	22.9	22.2	26.0	22.1	......	......	......	......	20.3	28.9	100	142.3
Thirteenth	......	......	12.0	19.7	21.5	21.1	28.1	24.1	......	......	......	......	18.6	24.4	100	131.2
Fourteenth	......	......	11.9	18.8	20.0	18.5	......	......	......	......	......	......	18.6	24.1	100	129.6
Fifteenth	......	......	9.6	17.8	......	......	......	......	......	......	......	......	16.9	23.9	100	141.7
Sixteenth	......	......	5.8	19.3	......	......	......	......	......	......	......	......	15.0	22.2	100	148.0
Seventeenth	......	......	......	......	......	......	......	......	......	......	......	......	20.7	26.3	100	127.1
Eighteenth	......	......	......	......	......	......	......	......	......	......	......	......	18.1	24.2	100	134.7
	142.8	201.3	220.2	338.9	317.5	338.6	335.9	317.2	162.6	225.8	108.2	136.9	......	......	......	......
	......	141.0	......	153.9	......	106.6	......	94.4	......	138.8	......	126.5	......	......	.....	......

In the American Chemical Journal for April 1890, H. J. Patterson, of the Maryland Agricultural Experiment Station, gives the results of his analyses when the ether extract was poured through a layer of animal charcoal, by which he obtained "in every case a product having the general appearance and characteristics of pure fat."

As compared with amount of ether extract, as obtained by the ordinary method, he obtained from several fodders and feeding material as follows:

PER CENT OF FATS IN ETHER EXTRACT.

Clover hay	57.55
Corn fodder	43.60
Corn meal	97.84
Cotton-seed meal	94.10
Sorghum fodder	49.45
Sorghum silage	59.84
Pea	51.16
Wheat bran	87.63

By adopting the above results of Dr. Stellwaag, we find that the ether extract or crude fat in the foods fed would be reduced from 4,588 pounds to 3,533 pounds, which amount is but 93.15 per per cent of the fat produced in the milk. There is, therefore, 6.85 per cent or 260 pounds unaccounted for.

H. P. Armsby gives as the per cent of fat in a well-fed ox as 8.7, in one half-fat 17.5 and in one fat 30.5. The cows under experiment at this Station had an average weight during the year of 816 pounds, or an aggregate of 11,424 pounds. They were all well fed and in good condition and would, at 8.7 per cent fat, have carried along an aggregate of 994 pounds of fat from which to supply any temporary demand over and above the supply in food, this would be a demand upon their stored up fat of less than two-thirds of an ounce per day during the fifteen months of lactation, or since this demand was mainly limited to the first three months of three and one-fourth ounces of fat per day, an amount so small as to be practically inappreciable.

It would appear therefore that whether or not the fat of the milk is wholly or in part obtained from the fat in the food, there is little if any room for doubt that ordinarily the food contains enough of fat to equal that produced in the milk.

We hope during the next season to plan a series of experiments which may add to our present knowledge concerning this problem.

FRACTIONAL MILKING.

In the ordinary method of milking a cow twice daily, it has long been known that the last portion drawn from the udder is much richer in fat than the earlier portion, and for the purpose of determining the extent of this difference as to amount of fat and the relative number and size of milk globules, the first and last pints of the milk of Nellie 6th (American Holderness) were, on the twenty-ninth and thirty-first of December, taken for analysis, and this was upon January twenty-fifth and February second done with several of the other cows, the results of which examinations are given in the following table. The results with the entire milk product well mixed together are given for comparison.

The numbers representing the average size are the average sizes measured by divisions of the micrometer scale. The numbers representing relative size are obtained by dividing the per cent of fat by the number of globules in .0001 cubic millimeter.

The most striking fact is the per cent of fat in the first and last pints on December thirty-first, which differed nearly twenty-fold, or 1 to 19.6.

In both experiments the difference in the average size of the globules is to be remarked, as also the number of globules in .0001 cubic millimeter, the latter differing over four-fold.

The very great increase of globules of different sizes and especially in the larger globules of the first pints and the last pints is especially noticeable and important.

Finally, the first pint was in reality no better than ordinary skim-milk, containing, as did the sample taken December thirty-first, but one-third of one per cent of fat, while the normal milk contained 2.55 per cent.

Upon the table following are given the results of the microscopic and chemical examination of five samples of milk from five different cows of three different breeds and in this case the milk was taken in halves.

It will be seen that there was a close resemblance in the results. In every case the first half contained only one-third to one-half the fat present in the last half. The average for the five giving 4.21 per cent of fat in the normal milk; 2.52 per cent in the first half and 5.89 per cent in the last half, or as 100 to 60 to 140. The same increase in the number of large globules is seen in the samples representing the last halves of each milking.

	DECEMBER 29.		DECEMBER 31.		
	First pint, Nellie.	Last pint, Nellie.	Mixed, Nellie.	First pint, Nellie.	Last pint, Nellie.
Average diameter, inches	$\frac{1}{16660}$	$\frac{1}{11393}$	$\frac{1}{13357}$	$\frac{1}{17409}$	$\frac{1}{11227}$
Number less than 1 division	12	25	28	14	35
Number between 1 and 2 divisions	14	80	52	10	88
Number between 2 and 3 divisions	2	27	11	3	27
Number between 3 and 4 divisions	0	5	5	0	10
Number between 4 and 5 divisions	0	2	0	0	3
Average size	.93	1.36	1.16	.89	1.38
Number in .0001 c. m. m.	51	235	105	45	208
Relative size	....	....	243	78	329
Per cent of fat in milk	....	....	2.55	.35	6.85

	JANUARY 25, 1892.						FEBRUARY 2, 1892.								
	Nellie, mixed.	Nellie, first half.	Nellie, second half.	Oriole, mixed.	Oriole, first half.	Oriole, second half.	Artalia, mixed.	Artalia, first half.	Artalia, second half.	Manton Belle, mixed.	Manton Belle, first half.	Manton Belle, second half.	Miss Flow 5th, mixed.	Miss Flow 5th, first half.	Miss Flow 5th, second half.
Width of tube	31	32	30	26	32	25	31	28	23	27	29	31	27	26	28
Number globules counted	80	59	117	41	44	62	63	30	50	74	46	83	143	77	130
Average size	1.07	1.34	1.18	1.51	1.69	1.52	1.33	1.28	1.25	1.18	1.03	1.21	.84	.89	.92
Number less than 1	34	21	43	11	11	20	23	12	18	36	23	40	91	46	64
Number between 1-2	32	18	46	15	14	12	22	9	16	22	15	20	39	22	54
Number between 2-3	14	15	23	9	11	23	10	8	10	11	6	14	12	9	9
Number between 3-4	0	5	5	6	5	7	5	0	6	2	1	7	0	0	3
Number between 4-5.	0	0	0	0	3	0	3	1	0	2	1	2	1	0	0
Number between 5-6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Average size in inches	1-14480	1-11563	1-13130	1-10261	1-9168	1-10193	1-11650	1-12105	1-12395	1-13130	1-15043	1-12805	1-18445	1-17409	1-16841
Number in .0001 c. m. m.	153	106	239	111	79	183	117	70	174	187	100	159	361	210	305
Relative size	235	198	213	549	530	437	372	300	379	202	220	336	90	100	144
Fat in milk	3.6	2.10	5.10	6.10	4.20	8.00	4.35	2.10	6.60	3.77	2.20	5.35	3.25	2.10	4.40

In continuing this investigation the milk from several cows was taken in successive pints, each pint being drawn from the four teats in approximately equal quantities. By the aid of an assistant the operation of milking was not prolonged over two or three minutes, and was without any apparent annoyance to the cow.

The successive pints were analyzed, and after the samples were taken for analysis, the remainders were mixed thoroughly, from which a sample was also taken for analysis.

The results appear upon the following tables as also the average results of the five experiments.

The most striking points brought out in these experiments are as follows:

1. The steady increase in the number of fat globules in a definite volume of milk (.0001 c. m. m.); also in the average and relative size of these globules.

2. The increase, in the later pints of milk drawn, in the number of the larger globules, and as a result.

3. The steady increase in the percentage of fat in the successive portions of milk.

It is interesting to observe that in the first half of the milk of the average table, the average per cent of fat was 2.02, while the average for the last half the per cent of fat was more than double, 4.28 per cent; and in the case of Nellie, January twentieth the average per cent of fat in the first half of the milk was .76, and in the last half was 3.09, or almost exactly as 1 to 4; and with Countess Flavia, February ninth, giving a milk very rich in fat, it was found that the average of the first half was 3.55 per cent and of the last half 7.01 per cent, very nearly as 1 to 2.

The secretion of milk as we have already shown is a regular and continuous process, the amount of milk capable of being drawn from the udder being exactly proportional to the length of time allowed for its secretion, it would appear that the phenomena which are shown by the examination of these fractional milkings, was due merely to what by comparison we may term "warm setting" within the udder and other milk vessels of the animal.

JANUARY 20, 1892 — NELLIE 6TH — "PINT MILKINGS."

	First pint.	Second pint.	Third pint.	Fourth pint.	Fifth pint.	Sixth pint.	Seventh pint.	Eighth pint.	Ninth pint.	Tenth pint.	Eleventh pint.	Twelfth pint.	Thirteenth pint.	Mixed.
Width of tube	30	29	27	31	32	31	30	32	26	26	28	26	28	25
Number globules counted	40	31	17	34	40	47	54	70	82	75	75	74	84	50
Number globules in standard tube	89	74	47	71	78	98	120	137	243	222	191	219	214	160
Average size	.82	.61	.88	.91	.65	.87	1.00	1.06	1.10	1.00	1.20	1.16	1.11	.91
Number between 0-1	24	25	8	20	26	27	24	35	41	40	37	31	35	27
Number between 1-2	14	6	8	10	12	16	23	20	25	22	18	27	31	15
Number between 2-3	2	0	1	3	0	3	5	14	14	10	16	13	17	7
Number between 3-4	0	0	0	1	0	1	2	0	2	3	2	2	1	1
Number between 4-5	0	0	0	0	2	0	0	0	0	0	1	1	0	0
Number between 5-6	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Number between 6-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number between 7-8	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Average size in inches	1-18895	1-25400	1-17607	1-17026	1-23837	1-17809	1-15494	1-14617	1-14085	1-15494	1-12912	1-13357	1-13958	1-17026
Number in .0001 c. m. m	82	68	43	65	72	90	110	126	223	204	176	201	197	147
Relative size	36	44	93	108	97	133	154	174	114	147	190	194	251	129
Fat in milk	.3	.3	.4	.7	.7	1.2	1.7	2.2	2.55	3.0	3.35	3.9	4.95	1.9

FEBRUARY 9, 1892 — COUNTESS FLAVIA — "PINT MILKINGS."

	First pint.	Second pint.	Third pint.	Fourth pint.	Fifth pint.	Sixth pint.	Seventh pint.	Eighth pint.	Ninth pint.	Tenth pint.	Eleventh pint.	Mixed.
Width of tube	26	27	25	30	26	29	30	31	33	31	34	36
Number globules counted	15	33	29	41	50	40	53	41	58	58	92	64
Number globules in standard tube	44	90	93	91	148	95	118	85	106	121	159	99
Average size	1.63	1.46	1.60	1.77	1.81	1.80	1.57	1.95	1.86	1.96	1.93	2.17
Number less than 1	4	15	13	8	14	8	23	8	12	11	15	6
Number between 1-2	6	4	4	13	8	10	7	9	18	17	24	17
Number between 2-3	2	10	6	12	17	12	12	14	19	13	31	20
Number between 3-4	2	3	2	7	9	10	9	9	5	10	14	14
Number between 4-5	1	1	4	1	2	0	2	1	4	7	7	6
Number between 5-6	0	0	0	0	0	0	0	0	0	0	1	1
Average size in inches	1-9505	1-10612	1-9683	1-8753	1-8560	1-8608	1-9869	1-7945	1-8330	1-7905	1-8028	1-7140
Number in .0001 c. m. m.	40	83	85	84	136	87	108	78	97	111	146	91
Relative size	387	367	388	476	323	575	565	833	722	725	644	659
Fat in milk	1.55	3.05	3.30	4.00	4.40	5.00	6.10	6.50	7.00	8.05	9.40	6.00

FEBRUARY 11, 1892 — QUEEN DUCHESS — "PINT MILKINGS."

	First pint.	Second pint.	Third pint.	Fourth pint.	Fifth pint.	Sixth pint.	Seventh pint.	Eighth pint.	Ninth pint.	Tenth pint.	Eleventh pint.	Mixed.
Width of tube	33	31	31	33	39	23	24	27	25	32	28	32
Number globules counted	38	52	65	84	81	48	48	49	64	89	58	60
Number globules in standard tube	70	108	135	154	106	181	166	134	205	174	148	122
Average size	1.26	0.92	1.35	1.23	1.02	1.01	1.20	1.15	1.28	1.29	1.38	1.15
Number less than 1	15	29	26	35	46	24	27	23	25	27	19	30
Number between 1-2	12	17	15	29	20	12	10	16	19	38	22	16
Number between 2-3	8	5	20	12	12	12	6	6	17	18	11	10
Number between 3-4	3	1	3	7	2	0	1	3	3	6	4	3
Number between 4-5	0	0	1	1	1	0	4	1	0	0	1	2
Number between 5-6	0	0	0	0	0	0	0	0	0	0	1	0
Average size in inches	1-12297	1-16841	1-11477	1-12597	1-15190	1-15340	1-12912	1-13473	1-12105	1-12011	1-11227	1-13482
Number in .0001 c. m. m	64	99	124	142	97	166	154	123	189	160	136	112
Relative size	250	212	193	169	237	129	156	219	153	231	393	252
Fat in milk	1.6	2.1	2.4	2.4	2.3	2.15	2.4	2.7	2.9	3.7	5.35	2.76

FEBRUARY 18, 1892 — ARTALIA — "PINT MILKINGS."

	First pint.	Second pint.	Third pint.	Fourth pint.	Fifth pint.	Sixth pint.	Seventh pint.	Eighth pint.	Ninth pint.	Tenth pint.	Mixed.
Width of tube	24	26	24	26	28	24	26	25	24	25	24
Number globules counted	12	20	23	48	30	48	48	49	58	58	43
Number globules in standard tube	42	59	80	142	76	167	142	157	201	186	152
Average size	1.08	1.40	1.33	1.13	1.12	1.57	1.26	1.47	1.65	1.50	1.34
Number between 0-1	6	7	9	21	12	15	19	18	12	15	15
Number between 1-2	5	5	7	17	15	11	14	12	23	21	12
Number between 2-3	0	6	4	9	1	17	11	14	13	16	12
Number between 3-4	1	2	2	1	1	5	4	3	8	5	3
Number between 4-5	0	0	1	0	1	0	0	2	1	1	2
Number between 5-6	0	0	0	0	0	0	0	0	1	0	0
Average size in inches	1-14346	1-11067	1-11650	1-13711	1-13834	1-9869	1-12297	1-10540	1-9390	1-10329	1-10695
Number in .0001 c. m. m	39	54	73	131	70	154	131	144	185	171	140
Relative size	128	204	178	137	342	221	340	347	270	365	218
Fat in milk	.5	1.1	1.3	1.8	2.4	3.4	4.45	5.	5.	6.25	2.77

FEBRUARY 24, 1892 — NELLIE — "PINT MILKINGS."

		First pint.	Second pint.	Third pint.	Fourth pint.	Fifth pint.	Sixth pint.	Seventh pint.	Eighth pint.	Ninth pint.	Tenth pint.	Eleventh pint.	Twelfth pint.	Thirteenth pint.	Mixed.
	Width of tube	48	50	48	48	36	28	32	31	33	31	33	26	27	27
	Number globules counted	65	68	92	133	87	83	71	114	98	128	121	133	135	61
	Number globules in standard tube	56	54	80	115	134	212	139	237	180	266	222	393	370	167
	Average size	.85	1.0	1.08	1.16	.97	1.17	1.15	1.12	1.10	1.10	1.03	1.12	1.11	1.09
	Number between 0-1	38	37	44	56	39	38	28	47	39	58	61	48	54	30
	Number between 1-2	20	22	31	47	39	24	30	44	41	45	39	53	56	18
	Number between 2-3	7	7	16	25	8	17	12	22	16	23	18	26	24	12
	Number between 3-4	0	2	1	5	1	4	0	1	2	2	3	6	1	1
	Number between 4-5	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Number between 5-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Average size in inches	1-18228	1-15494	1-14346	1-13357	1-15973	1-13243	1-13473	1-13834	1-14085	1-14085	1-15043	1-13834	1-13958	1-14215
	Number in .0001 c. m. m	51	50	74	106	123	195	128	218	166	245	204	361	340	154
	Relative size	59	120	135	113	110	77	133	105	169	135	211	130	162	175
	Fat in milk	.3	.6	1.0	1.2	1.35	1.5	1.7	2.3	2.8	3.3	4.3	4.7	5.5	2.7
	Solids not fat	9.41	9.36	9.33	......	......	......	......	......	......	......	9.80	9.94	10.47	......
	Ash	.796	.742	.821	......	......	......	......	......	......	......	.743	.679	.624	......
Feb. 23	Fat in milk	3.	......	......	......	......	......	......	......	......	......	......	......	......	......
Feb. 24	Fat in milk	2.7	......	......	......	......	......	......	......	......	......	......	......	......	......
Feb. 25	Fat in milk	2.6	......	......	......	......	......	......	......	......	......	......	......	......	......

AVERAGE RESULTS OF FRACTIONAL MILKINGS — PINTS.

	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Whole milk.
Number globules under first division..	47	55	43	38	48	41	45	41	35	35	34	37	42	36
Number globules between 1 and 2	35	25	26	35	29	27	28	28	33	35	29	44	38	28
Number globules between 2 and 3......	12	15	22	18	14	24	17	22	23	20	24	15	19	23
Number globules between 3 and 4	5	4	5	8	6	8	7	6	6	8	8	3	1	9
Number globules between 4 and 5......	1	1	4	1	3	0	3	2	2	3	3	1	0	4
Number globules between 5 and 6......	0	0	0	0	0	0	0	1	1	0	2	0	0	1
Number globules in .0001 c. m. m.......	55	71	80	106	100	138	126	138	172	178	166	281	269	129
Average size globules	1.03	1.07	1.25	1.24	1.11	1.28	1.24	1.35	1.40	1.37	1.11	1.14	1.11	1.14
Relative size globules	172	189	197	201	222	226	270	336	286	321	360	167	206	251
Per cent fat in milk	.85	1.43	1.68	2.02	2.23	2.65	3.27	3.74	4.05	4.86	4.48	4.30	5.23	3.21

Upon February twenty-fourth the experiment with Nellie gave, as the average of the first three pints of milk, 9.37 per cent of solids not fat, and .786 per cent of ash, facts which prove that the difference in the successive portions of milk drawn were almost wholly in the relative amount of fat they contained.

COMPOSITION OF MILK.

The following table gives the average daily milk yield and the composition of the milk of the several breeds under investigation, and the percentage composition of the total solids of the milk. It will be seen that this table gives the average results from an aggregate of 930 analyses.

It will be seen that while the average per cent of caseine in the milk of the different breeds varies from 3.39 to 3.91 or 15.3 per cent, the per cent of fat varies from 3.46 to 5.61 or 62.1 per cent, while the sugar varies from 4.84 to 5.33 or 10.1 per cent, and the ash from .698 to .760 or 8.9 per cent.

According, therefore, to the above table the ash varies least among the above constituents of milk, sugar next, then caseine, and fat, by far, in excess of all, varying over four times as much as caseine. This fact would clearly demonstrate that the per cent of fat present is the most reliable test by which to determine the relative value of normal milk not only for butter production but also for the manufacture of cheese.

If, however, we consider the percentage composition of the total solids in the milk we find the variation to be somewhat different, since, as will be seen, the caseine varies from 24.7 to 27.4 or 10.9 per cent, the sugar from 33.4 to 40.8 or 22.2 per cent, the ash from 4.82 to 5.92 or 23 per cent, and fat from 27.3 to 36.4 or 33.3 per cent, or very appreciably more than either of the other constituents of the total solids.

It is to be remembered that these results may differ as the animals become more mature, and can only be urged as true for the first period of lactation; but the results thus far secured conclusively establish the fact that despite the great differences which we find in the individuals even of the same breed, there are marked differences which characterize the milk from the different breeds.

Every step of the investigation thus far emphasizes the importance of intelligent choice by the dairyman of the breed best suited to his purpose, and equally the importance of carefully testing and selection for the purpose of securing individuals which will, with greatest economy, furnish him the dairy product he desires, whether intended for the city, the creamery or the cheese factory.

AVERAGE COMPOSITION OF MILK.

BREEDS.	Number of analyses.	Water.	Total solids.	Solids not fat.	Fat.	Caseine.	Sugar.	Ash.	Nitrogen.	Daily milk yield.
Holstein-Friesian	132	87.62	12.39	9.07	3.46	3.39	4.84	.735	.540	22.65
Ayrshire	252	86.95	13.06	9.35	3.57	3.43	5.33	.698	.543	18.40
Jersey	238	84.60	15.40	9.80	5.61	3.91	5.15	.743	.618	14.07
American Holderness	124	87.37	12.63	9.08	3.55	3.39	5.01	.698	.535	13.40
Guernsey	112	85.39	14.60	9.47	5.12	3.61	5.11	.753	.570	16.00
Devon	72	86.26	13.77	9.60	4.15	3.76	5.07	.760	.595	12.65
Average	....	86.37	13.64	9.40	4.24	3.58	5.09	.731	.534	16.20

AVERAGE COMPOSITION OF TOTAL SOLIDS — PER CENT.

BREEDS.	Total solids.	Solids not fat.	Fat.	Caseine.	Sugar.	Ash.
Holstein-Friesian	100	73.2	28.0	27.4	39.1	5.93
Ayrshire	100	71.6	27.3	26.3	40.8	5.34
Jersey	100	63.6	36.4	25.4	33.4	4.82
American Holderness	100	71.9	28.1	26.8	39.7	5.53
Guernsey	100	64.9	35.1	24.7	35.0	5.16
Devon	100	69.7	30.1	27.3	36.8	5.52
Average	100	69.2	30.8	26.3	37.5	5.38

MICROSCOPIC EXAMINATION OF MILK.

The first two tables following present the average number of milk globules actually counted and their relative sizes during each month of lactation for each breed; and the tables next following present these results per thousand globules for greater ease of comparison; and another table gives the general average of these results for all the breeds.

It will be observed that, as the period of lactation advances, the relative number of the smaller globules increases with considerable regularity, and especially is this the case up to the twelfth month of lactation, after which the number of animals for comparison dropped off. In contrast it will be seen that the relative number of the larger globules, especially those from three to six divisions upon the micrometer scale in diameter, steadily diminish as lactation advances.

The average results giving the number of globules of different sizes present in 100 globules and extending during the entire period of lactation is highly interesting, as showing a close relation between certain of the breeds in the character of their products. These average results are here brought together for comparison.

AVERAGE SIZE AND NUMBER OF GLOBULES.

	0-1.	1-2.	2-3.	3-4.	4-5.	5-6.
Holstein-Friesian	145	546	245	51	11	2
Ayrshire	146	540	234	62	16	2
American Holderness	114	538	282	57	8	1
Devon	107	521	280	79	12	1
Jersey	81	383	321	181	53	11
Guernsey	65	389	350	144	44	7

A glance at the above shows a remarkable resemblance between the milk from the Holstein-Friesians and the Ayrshires upon the one hand, and between the Jerseys and Guernseys upon the other, while the American Holderness and Devons appear to occupy a midway position.

The large number of small globules and relatively small number of the larger globules of the Holstein-Friesians and Ayrshires, as contrasted with the opposite character of the Jersey and Guernsey milks, is very remarkable.

The bearing of these facts upon the deportment of milk in the process of creaming is obvious, but the matter will be discussed further on. Another table gives the actual average diameter in fractions of an inch of the milk globules of each cow during each month of lactation, and it will be seen that while the average diameters of the globules of the milk of the different animals differ very widely, there is, in every case, a gradual diminution in the size of the globules during the successive months of lactation.

Another table gives the average number and sizes of the milk globules, the average number counted at each examination, the average size and diameter and the number of microscopic analyses made of the milk of each animal during the entire period of lactation.

It comprises the results of an actual count and measurement of 44,836 globules from the milk of fifteen cows of the six breeds under investigation. There were in all 454 examinations, with an average of ninety-nine globules measured and counted at each examination, and averaging thirty examinations for each cow. These details are given in order that the proper degree of confidence in the recorded results may be determined.

Still another table gives the average size of milk globules of each animal and for each breed during the entire period of lactation, and this table also shows the general grouping of the several breeds as is more plainly seen when we compare the number of globules of each size, as is shown upon page 151.

NUMBER AND SIZE OF MILK GLOBULES DURING LACTATION.

MONTH OF LACTATION.	HOLSTEIN-FRIESIAN.							AYRSHIRE.							AMERICAN HOLDERNESS.						
	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.
First	2	48.	85.	83.	41.	13.	6.	4	62.	273.	217.	91.	54.	4.	2	39.	256.	180.	55.	8.	1.
Second	2	46.	103.	80.	28.	5.	0.	4	112.	640.	396.	127.	22.	4.	2	13.	202.	154.	63.	19.	2.
Third	2	30.	125.	86.	21.	4.	1.	4	107.	517.	283.	59.	11.	0.	2	12.	230.	146.	21.	7.	1.
Fourth	2	79.	148.	118.	34.	10.	0.	4	171.	456.	249.	77.	13.	3.	2	1.	117.	73.	20.	1.	0.
Fifth	2	10.	171.	126.	20.	2.	0.	4	111.	310.	189.	53.	3.	1.	2	56.	417.	186.	46.	4.	0.
Sixth	2	7.	148.	87.	21.	3.	1.	4	103.	709.	321.	63.	17.	2.	2	50.	393.	191.	28.	4.	0.
Seventh	2	44.	646.	329.	47.	8.	1.	4	60.	419.	178.	43.	7.	0.	2	71.	430.	223.	34.	1.	0.
Eighth	2	164.	648.	180.	42.	5.	0.	4	87.	536.	222.	49.	5.	0.	2	35.	199.	112.	17.	0.	0.
Ninth	2	99.	332.	61.	11.	2.	0.	4	112.	533.	163.	36.	4.	2.	2	86.	423.	257.	38.	3.	0.
Tenth	1	27.	69.	27.	7.	4.	0.	3	113.	272.	121.	18.	4.	0.	2	69.	194.	74.	9.	1.	0.
Eleventh	1	26.	69.	30.	7.	1.	0.	3	138.	563.	168.	22.	1.	0.	2	27.	91.	36.	8.	1.	0.
Twelfth	1	34.	153.	60.	3.	0.	0.	2	105.	252.	76.	8.	2.	0.	2	26.	96.	52.	12.	1.	0.
Thirteenth	1	17.	67.	22.	2.	0.	0.	1	14.	75.	32.	13.	2.	0.	2	44,	167.	83.	18.	3.	0.
Fourteenth	1	35.	173.	72.	5.	1.	0.	1	35.	175.	69.	10.	1.	0.	1	85.	233.	90.	15.	3.	0.
Fifteenth	1	31.	183.	74.	9.	0.	0.	1	42	134.	22.	7.	3.	1.	1	8.	15.	6.	0.	0.	0.
Sixteenth	1	60.	350.	75.	5.	0.	0.	1	18.	26.	11.	6.	3.	1.	......	......	......	......	......	......	......
Seventeenth	1	99.	184.	32.	5.	1.	1.	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Average	......	133.	568.	240.	48.	9 2	1.5	......	128.	543.	250.	63.	14.	1.7	......	97.	542.	291.	60.	8.8	.6

NUMBER AND SIZE OF MILK GLOBULES DURING LACTATION.

MONTH OF LACTATION.	JERSEYS.							GUERNSEYS.							DEVONS.						
	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.
First	3	38.	106.	149.	111.	35.	11.	2	5.	59.	53.	30.	25.	7.	2	46.	377.	300.	128.	18.	3.
Second	3	24.	114.	153.	93.	40.	3.	2	13.	181.	191.	129.	51.	14.	2	29.	261.	190.	75.	8.	0.
Third	3	11.	46.	59.	40.	29	13.	2	11.	182.	207.	109.	37.	1.	2	27.	148.	96.	22.	5.	0.
Fourth	3	53.	97.	95.	44.	14.	0.	2	24.	234.	185.	90.	12.	1.	2	11.	105.	91.	23.	5.	2.
Fifth	3	31.	205.	216.	78.	28.	6.	2	16.	97.	79.	36.	8.	3.	2	17.	149.	85.	21.	0.	0.
Sixth	3	8.	189.	168.	110.	46.	8.	2	15.	90.	89.	37.	11.	1.	2	38.	215.	90.	31.	2.	0.
Seventh	3	56.	312.	299.	136.	41.	6.	2	15.	218.	165.	49.	10.	3.	2	34.	281.	131.	22.	8.	0.
Eighth	3	32.	311.	394.	139.	26.	1.	2	17.	74.	58.	19.	1.	0.	1	25.	177.	57.	16.	0.	0.
Ninth	3	44.	228.	177.	84.	18.	3.	2	11.	64.	73.	19.	3.	0.	1	67.	121.	44.	6.	1.	0.
Tenth	3	29.	266.	203.	63.	18.	4.	2	16.	125.	127.	60.	6.	2.	1	9.	21.	8.	2.	1.	0.
Eleventh	3	34.	153.	105.	40.	14.	0.	2	36.	114.	83.	34.	14.	0.	......	......	......	......	......	......	......
Twelfth	3	26.	161.	115.	52.	15.	4.	2	61.	193.	146.	54.	12.	0.	......	......	......	......	......	......	......
Thirteenth	2	23.	168.	136.	53.	13.	3.	1	8.	33.	32.	6.	3.	0.	......	......	......	......	......	......	......
Fourteenth	8	51.	279.	158.	51.	15.	1.	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Fifteenth	3	106.	255.	138.	57.	16.	5.	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Sixteenth	1	11.	31.	38.	21.	10.	1.	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Seventeenth	1	25.	157.	44.	17.	1.	0.	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Average	......	76.	386.	332.	149.	48.	9.	......	58.	387.	346.	156.	45.	7.	......	83.	508.	299.	95.	13.	1.4

NUMBER IN ONE THOUSAND.

MONTH OF LACTATION.	HOLSTEIN-FRIESIAN.							AYRSHIRE.							AMERICAN HOLDERNESS.						
	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.
First	2	174.	308.	301.	147.	47.	22.	4	88.	389.	310.	130.	77.	6.	2	72.	475.	334.	102.	15.	2.
Second	2	176.	393.	305.	107.	19.	0.	4	86.	492.	305.	97.	17.	3.	2	29.	446.	340.	139.	42.	4.
Third	2	112.	468.	322.	79.	15.	4.	4	110.	529.	290.	60.	11.	0.	2	29.	552.	350.	50.	17.	2.
Fourth	2	203.	383.	302.	87.	25.	0.	4	176.	471.	257.	79.	14.	3.	2	5.	552.	344.	94.	5.	0.
Fifth	2	30.	520.	383.	61.	6.	0.	4	166.	465.	283.	79.	5.	2.	2	79.	588.	262.	65.	6.	0.
Sixth	2	26.	554.	326.	79.	11.	4.	4	85.	583.	264.	52.	14.	2.	2	75.	590.	287.	42.	6.	0.
Seventh	2	41.	601.	306.	44.	7.	1.	4	85.	592.	252.	61.	10.	0.	2	93.	567.	294.	45.	1.	0.
Eighth	2	158.	624.	173.	40.	5.	0.	4	97.	596.	247.	54.	6.	0.	2	96.	548.	309.	47.	0.	0.
Ninth	2	196.	657.	121.	22.	4.	0.	4	132.	628.	192.	41.	5.	2.	2	107.	524.	318.	47.	4.	0.
Tenth	1	202.	515.	202.	52.	29.	0.	3	214.	515.	229.	34.	8.	0.	2	199.	559.	213.	26.	3.	0.
Eleventh	1	195.	518.	226.	53.	8.	0.	3	155.	631.	188.	25.	1.	0.	2	166.	559.	221.	48.	6.	0.
Twelfth	1	136.	612.	240.	12.	0.	0.	2	237.	569.	171.	18.	5.	0.	2	139.	513.	278.	64.	6.	0.
Thirteenth	1	158.	620.	204.	18.	0.	0.	1	103.	551.	235.	96.	15.	0.	2	140.	530.	264.	57.	9.	0.
Fourteenth	1	122.	605.	252.	17.	4.	0.	1	120.	603.	240.	34.	3.	0.	1	200.	547.	211.	35.	7.	0.
Fifteenth	1	104.	616.	249.	31.	0.	0.	1	201.	641.	105.	34.	14.	5.	1	276.	517.	207.	0.	0.	0.
Sixteenth	1	123.	714.	153.	10.	0.	0.	1	277.	400.	169.	92.	46.	16.	......	......	......	......	......	......	......
Seventeenth	1	308.	571.	99.	16.	3.	3.	......	......	......	......	......	......	.....	......	.....	......	......	......	......	......
Average	......	145.	546.	245.	51.	11.	2.	......	146.	540.	234.	62.	16.	2.	......	114.	538.	282.	57.	8.	1.

NUMBER IN ONE THOUSAND.

MONTH OF LACTATION.	JERSEYS.							GUERNSEYS.							DEVONS.						
	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.
First	3	84	236	331	247	78	24	2	28	330	296	167	140	39	2	53	432	314	147	21	3
Second	3	56	267	358	218	94	7	2	22	313	330	223	88	24	2	52	464	337	133	14	0
Third	3	56	232	298	202	146	66	2	20	333	378	199	68	2	2	91	497	322	73	17	0
Fourth	3	175	320	314	145	46	00	2	44	428	339	165	22	2	2	46	443	384	97	21	9
Fifth	3	55	363	383	138	50	11	2	67	406	331	151	33	12	2	62	548	313	77	0	0
Sixth	3	15	357	318	208	87	15	2	62	371	366	152	45	4	2	101	572	240	82	5	0
Seventh	3	66	367	352	160	48	7	2	33	474	359	106	22	6	2	71	591	275	46	17	0
Eighth	3	35	345	436	154	29	1	2	101	438	343	112	6	0	1	91	644	207	58	0	0
Ninth	3	79	412	319	152	33	5	2	65	376	429	112	18	0	1	281	506	184	25	4	0
Tenth	3	50	456	348	108	31	7	2	48	372	378	178	18	6	1	220	512	195	49	24	0
Eleventh	3	98	442	304	116	40	0	2	128	406	295	121	50	0	......	......	......	......	......	......	......
Twelfth	3	70	432	308	139	40	11	2	131	414	313	116	26	0	......	......	......	......	......	......	......
Thirteenth	3	58	424	343	134	33	8	1	98	402	390	73	37	0	......	......	......	......	......	......	......
Fourteenth	3	92	503	284	92	27	2	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Fifteenth	3	184	442	239	99	28	8	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Sixteenth	1	98	277	339	188	89	9	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Seventeenth	1	102	644	180	70	4	0	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Average	......	81	383	321	151	53	11	......	65	389	350	144	44	7	......	107	521	280	79	12	1

SIZE OF MILK GLOBULES DURING LACTATION.

MONTH OF LACTATION.	ALL BREEDS.												
								IN 1,000 GLOBULES.					
	Number of cows.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.
First	15	239	1156	982	456	153	32	79	383	325	151	51	11.0
Second	15	236	1501	1164	515	145	23	66	419	325	144	40	6.4
Third	15	198	1248	867	272	93	16	74	463	322	101	34	5.9
Fourth	15	338	1157	811	288	55	6	127	436	305	108	21	2.3
Fifth	15	241	1349	881	254	45	10	87	485	317	91	16	3.6
Sixth	15	221	1744	946	290	83	12	67	529	287	88	25	3.6
Seventh	15	280	2306	1326	331	75	10	65	533	306	77	17	2.8
Eighth	14	360	1945	923	282	37	1	102	548	260	79	10	.3
Ninth	14	419	1701	778	194	31	5	134	544	249	62	10	1.6
Tenth	12	263	947	560	159	34	6	134	481	284	81	17	3.0
Eleventh	11	261	991	422	111	31	0	144	546	232	61	17	.0
Twelfth	10	242	851	449	129	30	4	142	499	263	76	18	2.3
Thirteenth	8	106	510	305	92	21	3	102	492	294	89	20	2.9
Fourteenth	6	206	860	379	81	20	1	133	556	245	52	13	.7
Fifteenth	6	187	587	240	73	19	6	168	528	216	66	17	5.4
Sixteenth	3	89	407	124	32	13	2	133	610	186	48	20	3.0
Seventeenth	2	124	341	76	22	2	1	219	602	134	39	3.5	1.8
Average	......	236	1153	661	211	52	8	116	509	268	83	20.6	3.3

AVERAGE DIAMETER IN INCHES OF MILK GLOBULES IN EACH MONTH OF LACTATION.

The numbers given are denominators the numerators being 1.

NAMES OF COWS.	MONTH OF LACTATION.																			
	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.	Fourteenth.	Fifteenth.	Sixteenth.	Seventeenth.	Eighteenth.	Nineteenth.	Twentieth.
BREED — JERSEY.																				
Gilderbloom	7832	7527	6737	6508	7564	7013	7346	7791	8663	8123	10265	8966	5224	9749	10549	......	......	......	......	......
Countess Flavia	......	......	5856	5823	6624	8724	7998	7601	7749	7279	6405	8123	7791	7490	7675	7379	7246	7416	11160	9942
Barbara Allen	......	7112	7013	6769	8566	7078	6891	8164	8299	8343	8210	8477	7712	9458	8299	8343	......	......	......	......
BREED — HOLSTEIN-FRIESIAN.																				
Tolsma Artis	......	8164	8164	9458	10401	......	11372	10919	10401	14085	14215	......	......	......	......	......	......	......	......	......
Esel 2d	6370	8477	9117	10200	9176	9749	10007	10071	10697	11690	9813	10697	11584	10771	10549	12200	13133	......	......	......
BREED — AYRSHIRE.																				
Miss Flow 5th	......	......	......	......	9232	8966	11266	12024	......	11067	9942	9571	......	......	......	......	......	......	......	......
Queen Duchess	7212	7279	7379	9289	11067	9402	9515	9813	9458	9232	9458	9458	9942	9878	10329	12024	......	......	......	......
Manton Belle	7998	8764	9016	9289	9232	9628	10549	9878	104[illegible]5	10845	11802	13474	......	......	......	......	......	......	......	......
Junietta Peerless	7957	8915	10265	9749	9684	10993	10993	11478	12700	14085	......	......	......	......	......	......	......	......	......	......
BREED — AMERICAN HOLDERNESS.																				
Maggie 6th	......	7564	8713	9878	8081	9016	9628	9458	9628	9515	9749	10007	10329	10071	1215	......	......	......	......	......
Nellie 6th	......	10265	10071	9628	9942	11802	10200	10200	10007	11266	13955	11266	11160	......	12015	......	......	......	......	......
BREED — GUERNSEY.																				
Oriole	5936	6320	6653	8164	6830	6508	6952	6891	8040	7013	8388	8521	......	......	......	......	......	......	......	......
Rosette Ford	6653	6860	6536	8432	6982	8210	8713	7527	10549	7957	7179	7453	9942	......	......	......	......	......	......	......
BREED — DEVON.																				
Ione	7957	8343	8764	8254	9749	9684	9942	11067	11796	......	......	......	......	......	......	......	......	......	......	......
Genevie's Gift	7527	7957	8343	9117	9067	8663	9458	......	......	......	......	......	......	......	......	......	......	......	......	......

AVERAGE NUMBER AND SIZE OF GLOBULES DURING ENTIRE PERIOD OF LACTATION.

		Less than one.	One to two.	Two to three.	Three to four.	Four to five.	Five to six.	Total number.	Average size.	Diameter in inches.	Number of counts.
Jersey	Gilderbloom	14	57	26	12	......	......	109	1.52	$\frac{1}{10200}$	31
	Countess Flavia	17	35	29	9	6	......	96	1.72	$\frac{1}{9016}$	40
	Barbara Allen	7	48	15	9	5	2	86	1.73	$\frac{1}{8966}$	32
Holstein-Friesian	Tolsma Artis	6	61	19	2	......	......	88	1.33	$\frac{1}{11796}$	36
	Esel 2d	42	197	54	4	......	......	297	1.25	$\frac{1}{12401}$	36
Ayrshire	Miss Flow 5th	21	102	37	6	1	......	167	1.38	$\frac{1}{11266}$	29
	Queen Duchess	4	7	0	2	......	......	13	1.19	$\frac{1}{13020}$	35
	Manton Belle	35	85	17	3	1	......	141	1.18	$\frac{1}{13133}$	28
	Junietta Peerless	18	97	23	1	......	.....	139	1.23	$\frac{1}{12549}$	26
American Holderness	Maggie 6th	29	80	29	6	1	......	145	1.31	$\frac{1}{11918}$	32
	Nellie 6th	4	11	3	2	......	.....	20	1.45	$\frac{1}{10697}$	25
Guernsey	Oriole	14	87	62	20	9	......	192	1.77	$\frac{1}{8764}$	30
	Rosette Ford	9	44	21	7	2	......	83	1.54	$\frac{1}{10007}$	31
Devon	Ione	10	82	19	9	......	.....	120	1.41	$\frac{1}{10993}$	13
	Genevie's Gift	7	45	32	6	......	......	90	1.58	$\frac{1}{9813}$	19
Average per cent		13.3	58.1	21.6	5.5	1.4	.1	......	......	......	....

AVERAGE SIZE OF MILK GLOBULES OF EACH ANIMAL DURING ENTIRE PERIOD OF LACTATION, IN INCHES:

		Fraction of an inch.	
Guernsey	Oriole	$\frac{1}{8764}$	....
Jersey	Barbara Allen	$\frac{1}{8966}$	....
Jersey	Countess Flavia	$\frac{1}{9016}$	....
Devon	Genevie's Gift	$\frac{1}{9813}$	....
Guernsey	Rosette Ford	$\frac{1}{10007}$	....
Jersey	Gilderbloom	$\frac{1}{10200}$	....
American Holderness	Nellie 6th	$\frac{1}{10697}$	....
Devon	Ione	$\frac{1}{10993}$	....
Ayrshire	Miss Flow 5th	$\frac{1}{11266}$	....
Holstein-Friesian	Tolsma Artis	$\frac{1}{11796}$	....
American Holderness	Maggie 6th	$\frac{1}{11918}$	....
Holstein-Friesian	Esel 2d	$\frac{1}{12401}$	....
Ayrshire	Junietta Peerless	$\frac{1}{12548}$	....
Ayrshire	Queen Duchess	$\frac{1}{13020}$	....
Ayrshire	Manton Belle	$\frac{1}{13133}$	....
	AVERAGE BY BREED.		
	Guernsey	$\frac{1}{9344}$	100
	Jersey	$\frac{1}{9631}$	103
	Devon	$\frac{1}{10370}$	111
	American Holderness	$\frac{1}{11274}$	121
	Holstein-Friesians	$\frac{1}{12090}$	128
	Ayrshire	$\frac{1}{12446}$	133

PHYSICAL EFFECTS OF PERIOD OF LACTATION ON MILK.

In the following table is presented the average results for all the animals for each month of lacation, giving the average diameter of the gloubles in fractions of an inch, their average volume in fractions of a cubic inch, their ratio of volume, weight and buoyancy of the globules, the average weight of the globules in fractions of a grain, and their average buoyancy in grains.

The diminution in the average diameter of the globules and still more in their volume, weight and buoyancy, which vary as the cubes of the diameter is most striking.

MONTH OF LACTATION.	Number of cows.	Average diameter of globules, inches.	Average volume of globules, × 10,000,000,000 cub. in.	Ratio of volume, weight and bouyancy.	Average weight of globules, grains, × 1,000,000,000,000.	Average buoyancy, grains, × 1,000,000,000,000.
1	8	$\frac{1}{7143}$	$\frac{1}{70}$	100	333	45
2	13	$\frac{1}{7843}$	$\frac{1}{92}$	76	250	34
3	14	$\frac{1}{7843}$	$\frac{1}{92}$	76	250	34
4	14	$\frac{1}{8333}$	$\frac{1}{110}$	63	208	28
5	15	$\frac{1}{8602}$	$\frac{1}{121}$	57	189	26
6	14	$\frac{1}{8696}$	$\frac{1}{126}$	54	185	25
7	15	$\frac{1}{9091}$	$\frac{1}{143}$	49	160	22
8	14	$\frac{1}{9195}$	$\frac{1}{148}$	47	155	21
9	13	$\frac{1}{9756}$	$\frac{1}{177}$	39	130	18
10	13	$\frac{1}{9524}$	$\frac{1}{165}$	42	139	19
11	12	$\frac{1}{9524}$	$\frac{1}{165}$	42	139	19
12	11	$\frac{1}{9302}$	$\frac{1}{154}$	45	149	20
13	7	$\frac{1}{9524}$	$\frac{1}{165}$	42	139	19
14	6	$\frac{1}{9524}$	$\frac{1}{165}$	42	139	19
15	6	$\frac{1}{9756}$	$\frac{1}{177}$	39	130	18
16	4	$\frac{1}{9524}$	$\frac{1}{165}$	42	139	19

The following table gives the average per cent of the total fat present in the globules of different sizes and for the several breeds, as also the general average for all.

For comparison we find the average per cent of globules of different sizes for all breeds and for the entire period of lactation to be as follows:

	Less than 1 division	1 to 2.	2 to 3.	3 to 4.	4 to 5.	5 to 6.
Per cent globules	11.6	50.9	26.8	8.3	2.1	.33=100
Per cent fat	.2	23.8	38.9	25.3	10.5	1. 3=100

It will be observed that those globules which were less than one division of the micrometer scale, though 11.6 per cent of the total number contained only two-tenths of one per cent of the total fat; also that over sixty-two per cent of the total number of globules were less than two divisions in diameter but contained but twenty-four per cent of the total fat; also that while but less than eleven per cent of the globules were over three divisions in diameter they contained over thirty-seven per cent of the fat.

If we examine the results with the several breeds we shall observe marked differences between them in this regard. For example we find that the Jerseys have about seventy per cent of their milk globules over three divisions in size, the Guernseys over fifty-five per cent, the Devons and American Holderness each thirty-five per cent, while the Ayrshires have twenty-four per cent and the Holstein-Friesians only 11.3 per cent over three divisions in size.

These characteristic differences are of prime importance in explaining the deportment of these milks in the operations of butter or cheese making.

It will be seen also that from the table given below that with the Jerseys the 62.5 per cent of the total fat in the milk is in 14.8 per cent of the total number of globules; with the Guernseys 55.4 per cent of the fat in 13.8 per cent of the globules; with the Devons 34.4 per cent of fat in 7.1 per cent of the globules; with the American Holderness 34.9 per cent of the fat in 5.8 per cent of the globules; with the Ayrshires 24.1 per cent of the fat in 3.0 per cent of the globules; and with the Holstein-Friesians 11.3 per cent of the total fat in the milk is found in 1.6 per cent of the total number of globules in the milk.

	Per cent of globules over 3 divisions in diameter.	Per cent of total butter in globules over 3 divisions in diameter.
Jerseys	14.8	62.5
Guernseys	13.8	55.4
Devons	7.1	34.4
American Holderness	5.8	34.9
Ayrshires	3.0	24.1
Holstein-Friesians	1.6	11.3

A glance at the above will show that the six breeds may readily be placed in three groups so far as the physical character of the milk produced goes.

PER CENT OF TOTAL FAT IN DIFFERENT SIZED GLOBULES.

	Less than 1.	1 to 2.	2 to 3.	3 to 4.	4 to 5.	5 to 6.
Jerseys	.1	11.3	26.1	30.7	23.9	7.9
Guernseys	.1	11.3	33.2	29.7	25.7	. ...
Devons	.1	23.0	42.5	34.4	....	.....
American Holderness	.3	24.7	40.1	27.6	7.3	.....
Ayrshires	.3	34.0	41.6	17.8	6.3	.....
Holstein-Friesians	.3	38.3	50.1	11.3	...	.....
Average	.2	23.8	38.9	25.3	10.5	1.3

THE ACTIVITY OF THE PHYSIOLOGICAL PROCESSES.

In the secretion of milk we have a ready and comparatively accurate means by which to measure the rapidity of physiological processes.

We have seen that several cows under experiment secreted night and day an average of seven-tenths of a pound of milk each hour, or nearly 19.6 cubic inches of milk. As an average of over 150 determinations with the milk of the fifteen animals of the six breeds, we learn that there were in one-ten-thousandth of a cubic millimeter of milk an average of 152 fat globules, and a little calculation will show that by each of these animals there were secreted each second an average of nearly 136,000,000 globules of fat.

Dr. Sturtevant, in the Trans. New York State Agricultural Society, 1872–6, page 98, mentions a specimen of Bovista giganticus (gigantic puff-ball) as growing in a single night, in damp weather, from the size of a mere point to that of an enormous gourd; and from an approximate calculation, it was found that in this plant not less than 20,000 new cells were formed every minute; and Kieser calculated that the tissue of some fungi augmented at the rate of 60,000 cells a minute. But wonderful as this activity of cell action in the vegetable world, it would appear almost sluggish by comparison with what we find true concerning the secretion of the fat globules in milk.

EFFECT OF SIZE OF GLOBULES UPON CREAMING.

In the creaming at the Station the milk is generally set in cans eighteen inches deep, and the skimming is done in the morning. This results, of course, in allowing one-half the milk to stand twenty-four hours, and the other half twelve hours before skimming.

As the result of fifty-six days' experiment, it was found that the milk which stood for twenty-four hours gave upon an average 18.93 per cent of its weight of cream, while the milk which stood twelve hours, gave upon an average 20.17 per cent of its weight in cream.

Now we have shown as the average of 465 analyses of morning's milk, and an equal number of samples of the evening's milk, that the average milk yield in the morning was 8.16 pounds, and in the evening 8.21 pounds; also that the average per cent of fat in the morning's milk was 4.26, and in the evening's milk it was 4.22 per cent.

It will be seen, therefore, by simple calculation, that the total fat of the morning's milk was to that in the evening's milk as 100 to 99.67, while the amount of cream from the morning's milk which had set twenty-four hours, was to that from the evening's milk which had set but twelve hours as 100 to 106.55.

This difference is obviously due to the fact that after the cream has practically risen, upon longer standing it shrinks in volume owing to the separation of a portion of the skim-milk from the lighter fats. It shows, however, the fallacy of estimates based alone on the number of spaces of cream which different samples of milk may furnish.

Upon an average it will be seen that the fat globules in the lower strata of milk must rise about one and one-third inches per hour, but owing to the minuteness of these globules, their apparently slow progress is indeed relatively very rapid, since it requires the smaller globules, represented as less in diameter than one division of the micrometer scale, to move each second over a space 200 times greater than the diameter of the globules.

Should we suppose a balloon twenty-five feet in diameter to rise with equal relative velocity, it would rise about one mile per second.

But the relative rapidity of the rise of the globules diminishes as their diameter increases, and the number of their diameters in distance through which the several sized globules measured, by divisions of micrometer scale, would pass at one and one-third inches per hour, is as follows:

Divisions of micrometer	.5	1.	1.5	2.	2.5	3.	3.5	4.	4.5	5.	5.5	6.
Number of diameters	199.	100.	66.	50.	40.	33.	28.	25.	22.	20.	18.	17.

The actual diameters in fractions of an inch, represented by these several divisions of the micrometer scale, are as follows:

Divisions of micrometer scale.	Fractions of one inch.	Divisions of micrometer scale.	Fractions of one inch.
.5	.0000473	3.5	.0003311
1.0	.0000946	4.0	.0003784
1.5	.0001419	4.5	.0004257
2.0	.0001892	5.0	.0004730
2.5	.0002365	5.5	.0005203
3.0	.0002838	6.0	.0005676

Now, since the resistance which these globules meet with in rising increases with the square of their diameter, while their ascensional force or buoyancy increases as their volumes, or as the cubes of their diameters, we may readily conclude that the larger globules are those first to reach the surface, and that if any fail to do so, it must be the smaller globules which the microscope should show in the skim-milk.

By means of the separator the centrifugal force increases the difference between the weight of the milk globule and the milk serum in which it is suspended, and since this difference thus increased will depend upon the size of the globules, it follows that the skim-milk from the separator should also show that the smaller globules only were left behind in this operation; and such we find to be the facts whether the skim-milk is obtained by setting or by the centrifugal.

Upon December 29, 1891, the American Holderness cow Nellie 6th, one month in milk, gave milk which by the Cooley system of setting and by the Baby separator yielded skim-milk of the following composition as determined by microscopic examination and the Babcock test of the fat. The composition of the whole milk is also given for comparison:

COW, NELLIE 6TH, DECEMBER 29, 1891.	Less than one.	One to two.	Two to three.	Three to four.	Average size.	Average size in inches.	Number in .0001 c. m. m.	Per cent of fat.
Skim-milk, Cooley system..	18	12	2	...	84	$\frac{1}{18445}$	40	.1
Separator skim-milk, Baby separator..............	28	19	....	...	72	$\frac{1}{20964}$	72	.1
Normal milk.............	28	52	11	5	116	$\frac{1}{13357}$	105	2.55

The results are excellent by both methods, and, as is seen, not only were practically all the globules above two divisions of the micrometer scale in diameter removed in the cream, but also by far the larger proportion of those present whose diameter was above one division of the scale were also recovered in the cream, since the ratio in number of globules less than one division in the skim-milk was to the number of those between one and two divisions as 100 to 67, while the ratio in the normal milk was as 100 to 186, thus proving that even if some of the globules below one division were recovered in the cream — a most unwarrantable supposition — there were recovered nearly two-thirds (sixty-four per cent) of those globules between one and two divisions in diameter, and practically all of those larger.

It will also be observed that while there was upon an average half as many fat globules in the skim-milk as in an equal volume of normal milk, the skim-milk contained only four per cent as much total fat as was present in the full milk.

These results are entirely in accord with the facts set forth in the table giving the "Per Cent of Total Fats in the Different Sized Globules," where it was shown that the Holderness milk contained but .3 per cent of its fat in globules of less diameter than one division of micrometer scale, and 24.7 per cent in those globules from one to two divisions of the scale in diameter;

although from seventy-five to eighty per cent of all the globules present in the milk were below two micrometer scale divisions in diameter.

As illustration of the great differences in milk in the operation of creaming, depending upon this difference in the relative size of the fat globules, the following experiment is given with one sample of Jersey and another sample of Ayrshire milk.

These two samples were set in half liter cylinders, at a depth of eleven inches, at 6.45 A. M. and at intervals, without disturbance of the milk, small portions were taken from the bottom for the determination of fat with the following results:

JERSEY MILK.

	C. C.	Per cent of fat.
8.00 A. M., drew from bottom	18	2.9
10.00 A. M., drew from bottom	28	1.5
11.30 A. M., drew from bottom	26	1.1
1.00 P. M., drew from bottom	28	1.0
1.00 P. M., drew from middle	26	6.4

AYRSHIRE MILK.

	C. C.	Per cent of fat.
8.00 A. M., drew from bottom	18	3.0
10.00 A. M., drew from bottom	28	2.3
11.30 A. M., drew from bottom	28	2.2
1.00 P. M., drew from bottom	25	1.7
1.00 P. M., drew from middle	27	3.5

The contrast is quite marked, and it will be seen that the Ayrshire milk, although containing far less fat, was, after six and a quarter hours, setting much richer in fat in its lower portion than was the Jersey milk. It will be seen, also, that after a fifth of the milk had been withdrawn the portion taken from the middle of the remaining 400 c. c. was richer than the original milk in fat in both cases.

This simple experiment shows also the fallacy of any attempt at determining the value of any method of creaming which depends upon the analysis of a small portion of milk drawn from the bottom of the sample under experiment.

CHANGES IN MILK GLOBULES DURING LACTATION.

It is well known that the average size of the milk globules diminishes during the progress of lactation, also that the yield of milk decreases in volume, also that the number of milk globules in a given volume of milk increases as lactation advances.

It is an interesting question in its physiological bearings and of great practical value to determine whether the actual number of fat globules secreted by the cow increases during the months of lactation.

Our records show an aggregate of 489 actual counts of samples of milk from fifteen cows and extending through an average of fourteen months lactation and the number of globules actually present in a given volume (.0001 c. m. m.) was determined in each case.

We have also the daily yield of milk of these cows during the same period. By dividing the period of lactation of each cow into four equal periods, we find upon an average that the milk yield for these periods given in percentages was as follows:

First period 100; second period 95; third period 76.2; fourth period 70.6. In a similar way we find that the number of fat globules in a definite volume of milk varied as follows:

First period 100; second period 144; third period 195; fourth period 267.

If now we combine these proportions we have the following as representing the actual number of globules of fat secreted, without regard to the milk yield, viz.: First period 100; second period 137; third period 149; fourth period 189.

It appears therefore that there is a rather steady increase in the number of fat globules secreted, and that upon an average there are eighty-nine per cent more present in the milk during the last than during the first quarter.

It would be interesting to know whether this increase is due to an increased development of the fat producing or secreting cells, a supposition not improbable in consideration of this being the first period of lactation with these animals; or may it be due to the breaking up of the larger fat globules, a very impropable supposition, although such breaking up would increase the number and decrease the size, both well known phenomena; or may it

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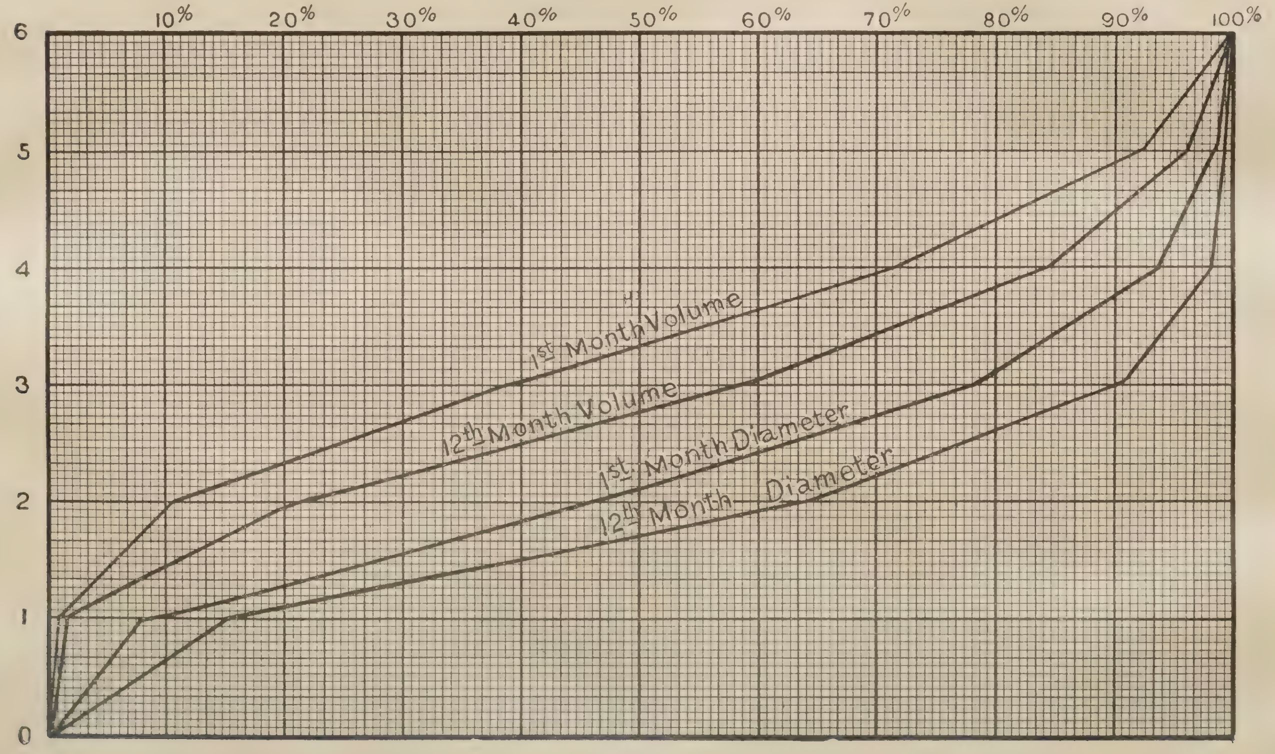
Changes in Diameter and Volume of Milk Globules.
During Lactation.



be caused by the cells becoming through long continued lactation unable to retain the larger globules which characterize the earlier secretions?

Certainly it would be desirable to discover some mode of treatment or method of feeding by which the size of these globules could be increased, thus increasing the yield of fat and facilitating many of the operations of the dairy.

The following table and diagram show the changes in diameter and volume of fat globules between the first and twelfth month of lactation.

The great increase in the percentage of globules of small diameter given is very marked, and an equally marked decrease in the percentage of the larger globules; and since the volumes vary as the cubes of the diameters, these differences are more strongly marked. It will be seen that during the first month 39.3 per cent of the fat was in globules less in diameter than three divisions of the micrometer scale and nearly sixty-one per cent in the larger globules, while in the twelfth month fifty-nine per cent of the fat was present in globules less than three divisions in diameter, while but forty-one per cent was present in the larger globules.

In the graphical chart the upper margin shows the percentages of volumes in the globules of different sizes as also the percentages of the globules of the different sizes given upon the left-hand margin. A glance shows that the change is a shifting in each case of the line representing diameters or volumes to the right-hand corner, or a general diminution of the diameter of the globules, and general increase in the volume of fat in the small globules. For example, during the first month of lactation there was about ten per cent of the fat in globules less than two micrometer scale divisions, while in the twelfth month there was over twenty per cent of the fat present in globules less than two divisions in diameter. So too in the first month there was less than eighty per cent of the globules under three divisions in diameter, while in the twelfth month there were ninety per cent under three divisions in diameter. It will also be seen how very small a percentage of the fat is present in the globules less than one division in diameter, although the number of globules is pretty large.

CHANGES IN DIAMETER AND VOLUME OF GLOBULES DURING LACTATION.

DIVISIONS ON MICRO. SCALE.	Diameter first month.	Diameter twelfth month.	Volume first month.	Volume twelfth month.
Less than one	7.9	14.2	.3	.7
One to two	38.3	49.8	10.1	20.9
Two to three	32.5	26.3	28.9	37.3
Three to four	15.1	7.6	31.7	25.5
Four to five	5.1	1.8	21.2	11.8
Five to six	1.1	.3	7.8	3.8

ANALYSIS OF FRUIT TREES.

An examination has been made of several varieties of nursery stock for the purpose of learning the quality and quantity of the mineral constituents removed by them from the soil.

The trees were contributed for the purpose by several of the leading nurserymen of Geneva from their stock, and were taken up early in the spring before the buds were well developed. The roots were as carefully cleaned of adhering earth as was possible, and after weighing, the trees were allowed to become air dry, when they were again weighed. Each tree was then divided into roots, trunk and branches, which were separately weighed, and after cutting up were placed in glass jars to await analysis. Each sample was burned at a low red heat, the ash weighed and preserved for analysis. It will be seen that the amount of ash in the roots and its composition in many cases seems to show that it was practically impossible to entirely remove from the roots the adhering earth.

The results thus far obtained are presented in the following tables:

WEIGHT OF ROOTS, BRANCHES AND TRUNKS OF NURSERY STOCK IN GRAMS.

Variety.	NAME.	Green tree.	Dry tree.	Water.	Dry roots.	Dry trunk.	Dry branches.	Roots, organic.	Roots, ash.	Trunk, organic.	Trunk, ash.	Branches, organic.	Branches, ash.	Total ash.
Apple	Hurlburt	1545.	844.7	700.3	355.3	393.2	89.7	339.9	15.43	381.8	11.36	85.4	4.32	31.11
Apple	Haas	713.	444.2	268.8	119.2	241.9	79.6	112.5	6.72	237.0	4.94	76.5	3.13	14.79
Apple	Golden Sweet	587.	339.2	247.8	122.9	145.7	69.1	118.6	4.34	142.4	3.33	67.0	2.10	9.77
Cherry	Yellow Spanish	1558.	854.8	703.2	357.0	339.5	153.3	344.9	12.08	332.7	6.75	146.2	7.14	25.97
Cherry	Napoleon Bigarreau	1143.	601.5	541.5	185.2	313.7	98.6	176.8	8.41	307.1	6.64	94.5	4.13	19.18
Cherry	Rockport Bigarreau	1786.	1104.0	682.0	335.3	504.5	257.2	321.7	13.61	496.9	7.57	91.0	7.61	28.79
Cherry	Windsor	2105.	1320.6	784.4	358.8	634.3	315.5	348.5	10.30	625.8	8.46	246.3	10.92	29.68
Peach	Honest John	247.	130.2	116.8	47.6	43.1	36.5	46.0	1.55	41.8	1.33	34.2	2.28	5.16
Peach	Red Roman	586.	314.6	271.4	129.0	111.9	73.7	125.5	3.52	123.2	2.28	69.4	4.25	10.05
Peach	Large Early York	347.	195.6	153.4	84.0	71.3	38.3	82 3	1.71	69.7	1.56	36.4	1.90	5.17
Peach	Heath Cling	608.	315.3	292.7	127.2	109.5	75.6	123.3	3.87	107.2	2.27	73.3	3.34	9.48
Peach	Stump	331.	180.3	150.7	61.2	71.6	45.0	59.5	1.71	69.8	1.82	42.6	2.42	5.95
Peach	Stevens Rareripe	464.	300.1	163.9	83.3	113.2	32.6	81.5	1.77	111.0	2.16	31.4	1.17	5.10
Peach	Solway	394.	224.9	169.1	87.9	84.6	52.4	84.9	2.99	83.1	1.51	50.7	1.65	6.15
Peach	Early Rivers	307.	193.7	113.3	84.1	56.7	30.8	81.2	2.92	55.5	1.19	29.3	1.54	5.65
Grape vine	Mixed	337.	174.5	162.5	......	......	174.5	......	......	......	......	169.1	5.36	5.36
Crab apples	Hyslop	873.	492.3	380.7	157.2	246.3	87.8	151.8	5.38	240.6	5.67	85.0	2.75	13.80
Crab apples	Orange	895.	498.8	390.2	174.2	246.6	77.0	166.3	7.85	236.1	10.53	73.6	3.39	21.77
Pear	Vicar	1336.	513.3	822.7	192.0	205.9	111.4	186.3	5.71	197.6	8.33	104.5	6.91	20.95
Pear	Doyenne d'Ete	1923.	1027.6	894.4	392.1	434.7	195.8	377.3	14.79	418.0	16.69	185.9	9.85	41.33
Pear	Howell	1316.	778.7	537.3	255.6	375.9	137.2	242.3	13.27	365.4	10.50	131.7	5.47	29.24
Pear	Duchess de Bordeaux	1394.	642.1	751.9	209.0	309.1	119.0	202.0	6.98	299.9	9.24	111.5	7.54	23.76
Pear	Flemish Beauty	1525.	782.9	742.1	156.4	475.0	148.5	152.3	4.13	461.3	13.69	142.3	6.21	24.03
Pear	Russian 508	559.	248.9	310.1	110.7	106.1	28.1	105.9	4.84	101.1	4.99	27.0	1.07	10.90
Pear	Russian 358	425.	183.4	241.6	45.4	115.4	19.6	42.6	2.75	111.9	3.52	18 6	.99	7.26
Pear	Refreshing Russian	530.	232.2	297.8	76.9	130.4	21.4	72.8	4.09	126.8	3.57	20.6	.77	8.43
Plum	Coe's Golden	848.	467.9	380.1	172.6	224.9	66.4	164.1	8.45	219.0	5.92	64.1	2.28	16.65
Plum	Gueii	1165.	652.2	512.8	199.4	226.7	221.5	190.9	8.45	222.4	4.25	212.4	9.15	21.85
Plum	Smith's Orleans	1139.	590.1	548.9	193.1	259.6	134.4	184.1	9.03	253.1	6.46	130.6	3.79	19.28
Plum	Peter's Yellow Gage	1194.	689.4	504.6	176.4	237.0	183.0	170.8	5.58	231.4	5.57	176.7	6.33	17.48
Quince	Missouri Mammoth	324.	164.3	159.7	62.4	64.5	34.4	58.9	3.48	61.9	2.59	32.5	1.92	7.99
Quince	Orange	1053.	593.1	459.9	285.2	175.6	125.8	270.4	14.77	168.8	6.76	120.4	5.39	26.92

PER CENT OF DRY MATTER AND ASH IN NURSERY STOCK.

Variety.	NAME.	Per cent of dry matter in roots.	Per cent of dry matter in trunk.	Per cent of dry matter in branches.	Per cent of ash in dry roots.	Per cent of ash in dry trunk.	Per cent of ash in dry branches.	Per cent of ash in green tree.	Per cent of ash in dry tree.	Weight ash in roots.	Weight ash in trunks.	Weight ash in branches.	Total ash in trees.	Total ash in 2,000 pounds green tree.
Apple	Hurlburt	42.4	46.9	10.7	4.34	2.89	4.92	2.01	3.68	15.43	11.36	4.32	31.11	40.4
Apple	Haas	27.0	54.9	18.1	5.64	2.04	3.93	2.07	3.33	6.72	4.93	3.13	14.78	41.5
Apple	Golden Sweet	36.4	43.1	20.5	3.53	2.29	3.04	1.66	2.88	4.34	3.34	2.10	9.78	33.3
	Average	35.3	48.3	16.4	4.50	2.41	3.96	1.91	3.30	......	......	......	......	.....
Cherry	Yellow Spanish	42.0	40.0	18.0	3.38	1.99	4.66	1.67	3.04	12.07	6.76	7.14	25.97	33.3
Cherry	Napoleon Bigarreau	31.0	52.5	16.5	4.54	2.12	4.19	1.68	3.19	8.41	6.65	4.13	19.19	33.6
Cherry	Rockport Bigarreau	30.6	46.0	23.4	4.06	1.50	2.96	1.61	2.61	13.61	7.57	7.61	28.79	32.2
Cherry	Windsor	27.4	48.5	24.1	2 87	1.33	3.46	1.41	2.25	10.30	8.46	10.92	29.68	28.2
	Average	32.8	46.8	20.5	3.71	1.74	3.82	1.59	2.77	......	......	......	......	.....
Peach	Honest John	37.4	33.9	28.7	3.26	3.09	6.25	2.09	3.96	1.55	1,33	2.28	5.16	41.8
Peach	Red Roman	41.0	35.6	23.4	2.73	2.04	5.77	1.71	3.20	3.52	2.28	4.25	10.05	34.3
Peach	Large Early York	43.4	36.8	19.8	2.03	2.19	4.91	1.48	2.64	1.71	1.56	1.90	5.17	29.6
Peach	Heath Cling	40.7	35.1	24.2	3.04	2.07	4.42	1.56	3.01	3.87	2.27	3.34	9.48	31.2
Peach	Stump	34.4	40.3	25.3	2.79	2.54	5.38	1.80	3.30	1.71	1.82	2.42	5.95	36.0
Peach	Steven's Rareripe	36.4	49.4	14.2	2.12	1.91	3.53	1.10	1.70	1.78	2.16	1.15	5.09	21.9
Peach	Salway	39.1	37.6	23.3	3.40	1.78	3.15	1.56	2.74	2.99	1.51	1.65	6.15	31.2
Peach	Early Rivers	49.0	33.0	18.0	3.47	2.10	5.00	1.84	2.92	2.92	1.19	1.54	5.65	36.8
	Average	40.2	37.7	22.1	2.86	2.22	4.80	1.64	2.93	......	......	......	......	....
Grape vines	Mixed	......	......	100.0	......	......	3.07	1.59	3.07	......	......	5.36	5.36	31.8
Crab apples	Hyslop	32.0	50.1	17.9	3.42	2.30	3.13	1.58	2.80	5.38	5.66	2.75	13.79	31.6
Crab apples	Orange	35.0	49.5	15.5	4.51	4.27	4.40	2.43	4.37	7.86	10.53	3.39	21.78	48.7
	Average	33.5	49.8	16.7	3.92	3.29	3.77	2.01	3.59	......	......	......	......	.....
Pear	Vicar	37.7	40.4	21.9	2.97	4.05	6.20	1.57	4.08	5.70	8.34	6.91	20.95	31.4
Pear	Doyenne d'Ete	38.3	42.5	19.2	3.77	3.84	5.03	2.15	4.05	14.79	16.69	9.85	41.33	43.0
Pear	Howell	33.3	48.9	17.8	5.19	2.79	3.99	2.22	3.76	13.27	10.49	5.47	29.23	44.4
Pear	Dutchess de Bordeaux	32.8	48.5	18.7	3.34	2.99	6.34	1.70	3.70	6.98	9.24	7.54	23.76	34.1
Pear	Flemish Beauty	20.1	60.9	19.0	2.64	2.88	4.18	1.58	3.07	4.13	13.68	6.21	24.02	18.4

PER CENT OF DRY MATTER AND ASH IN NURSERY STOCK — (*Concluded*).

Variety.	NAME.	Per cent of dry matter in roots.	Per cent of dry matter in trunk.	Per cent of dry matter in branches.	Per cent of ash in dry roots.	Per cent of ash in dry trunk.	Per cent of ash in dry branches.	Per cent of ash in green tree.	Per cent of ash in dry tree.	Weight ash in roots.	Weight ash in trunks.	Weight ash in branches.	Total ash in trees.	Total ash in 2,000 pounds green tree.
Pear	508 Russian	45.2	43.3	11.5	4.37	4.70	3.81	1.95	4.38	4.84	4.99	1.07	10.90	39.0
Pear	358 Russian	25.2	64.0	10.8	6.06	3.05	5.05	1.71	3.95	2.75	3.52	.99	7.26	34.2
Pear	Refreshing Russian.........	33.6	57.0	9.4	5.32	2.74	3.60	1.59	3.64	4.09	3.57	.77	8.43	31.8
	Average..................	33.3	50.7	16.0	4.21	3.38	4.78	1.81	3.83	......	......	......	......	.....
Plum	Coe's Golden..................	37.2	48.5	14.3	4.89	2.63	3.43	1.96	3.56	8.45	5.92	2.28	16.65	39.2
Plum	Gueii	30.8	35.0	34.2	4.24	1.87	4.13	1.87	3.35	8.45	4.24	9.15	21.84	37.5
Plum	Smith's Orleans..............	32.9	44.2	22.9	4.68	2.45	2.82	1.69	3.27	9.04	6.46	3.79	19.29	33.7
Plum	Peter's Yellow Gage	29.6	39.7	30.7	3.16	2.35	3.45	1.46	2.54	5.57	5.57	6.33	17.47	29.2
	Average..................	32.6	41.9	25.5	4.24	2.33	3.46	1.75	3.18	......	......	......	......	.....
Quinces	Missouri Mammoth.........	38.8	39.9	21.3	5.58	4.02	5.58	2.47	4.86	3.48	2.59	1.92	7.99	49.3
Quinces	Orange.........................	48.7	29.9	21.4	5.18	3.85	4.28	2.56	4.54	14.77	6.76	5.38	26.91	51.1
	Average..................	38.8	34.9	21.4	5.38	3.94	4.94	2.52	4.70	......	......	......	......	.....

PERCENTAGE COMPOSITION OF ASH OF NURSERY STOCK.

		BRANCHES.									
		SiO_2.	P_2O_5.	Cl.	SO_3.	CO_2.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Apple	Haas	1.81	7.35	1.19	3.02	21.83	.00	43.68	10.02	2.51	8.59
Apple	Golden Sweet	2.49	5.89	.29	2.96	29.24	.00	40.60	8.07	7.09	3.37
Apple	Hurlburt	2.60	4.44	.57	3.57	33.61	.64	41.55	2.88	4.98	5.16
	Average	2.30	5 89	.68	3.18	28.23	.21	41.94	6.99	4.86	5.71
Cherry	Napoleon Bigarreau	2.25	6.72	.27	5.04	22.21	.00	44.94	7.35	5.95	5.27
Cherry	Yellow Spanish	2.49	7.03	.25	2.68	24.30	.00	40.92	7.87	5.52	8.94
Cherry	Windsor	4.43	5.56	.36	2.36	24.00	1.33	41.51	6.52	4.15	9.78
Cherry	Rockport Bigarreau	3.34	3.85	.29	1.51	18.76	.46	45.50	7.24	11.20	7.85
	Average	3.13	5.79	.29	2.90	22.32	.45	43.22	7.27	6.71	7.96
Pear	Howell	5.82	5.09	.29	3.38	12.70	.00	43.54	9.55	8.02	11.61
Pear	Doyenne d'Ete	3.76	5.99	.27	1.86	27.09	.00	38.50	6.23	7.33	8.97
Pear	Flemish Beauty	3.15	4.12	.28	3.86	21.77	.00	43.05	7.06	6.72	9.99
	Average	4.24	5.07	.28	3 03	20.52	.00	41.70	7.61	7.36	10.19

PERCENTAGE COMPOSITION OF ASH OF NURSERY STOCK—(*Continued*).

		TRUNKS.									
		SiO_3.	P_2O_5.	Cl.	SO_3.	CO_2.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Apple	Haas	2.04	6.13	.40	7.55	21.77	.00	44.52	9.30	1.33	6.96
Apple	Golden Sweet	4.98	4.61	.28	1.17	30.46	.00	41.96	4.61	3.91	8.02
Apple	Hurlburt	3.93	4.08	.61	3.85	33.72	.00	44.80	5.22	2.48	1.31
	Average	3.65	4.94	.43	4.19	28.65	.00	43.76	6.38	2.57	5.43
Cherry	Napoleon Bigarreau	8.27	5.38	.23	3.60	28.18	1.26	39.62	5.59	3.18	4.69
Cherry	Yellow Spanish	6.39	5.30	.22	4.17	22.41	.94	41.09	6.13	5.29	8.06
Cherry	Windsor	5.53	4.22	.29	2.76	22.51	.72	41.44	6.45	8.13	7.95
Cherry	Rockport Bigarreau	4.30	3.42	.28	2.78	26.18	.40	44.80	5.43	4.79	7.62
	Average	6.12	4.58	.26	3.33	23.70	.83	41.74	5.90	5.35	7.08
Pear	Howell	3.59	3.93	.27	2.85	28.34	.23	44.48	6.40	3.27	6.64
Pear	Doyenne d'Ete	3.33	4.76	.29	2.72	29.31	.14	39.34	4.92	7.20	7.98
Pear	Flemish Beauty	4.00	3.77	.28	3.59	24.31	.37	41.98	6.69	7.38	7.63
	Average	3.64	4.15	.28	3.05	37.32	.25	41.93	6.00	5.95	7.42

PERCENTAGE COMPOSITION OF ASH OF NURSERY STOCK — (*Concluded*).

		ROOTS.									
		SiO_2.	P_2O_5.	Cl.	SO_3.	CO_2.	Fe_2O_3.	CaO.	MgO.	NaO.	K_2O.
Apple	Haas	26.84	9.44	0.42	5.11	1.42	4.32	32.98	9.30	4.74	5.43
Apple	Golden Sweet	27.65	7.71	0.45	2.83	20.66	3.00	26.99	4.84	3.87	2.00
Apple	Hurlburt	25.72	4.17	0.25	6.19	8.27	2.75	25.20	10.37	7.22	9.86
	Average	26.74	7.11	0.37	4.71	10.12	3.36	28.39	8.17	5.28	5.76
Cherry	Napoleon Bigarreau	31.92	5.80	0.25	4.05	18.48	2.29	22.40	4.68	3.63	6.50
Cherry	Yellow Spanish	32.68	8.67	0.26	5.84	9.08	2.24	22.89	5.39	7.42	5.53
Cherry	Windsor	37.55	7.86	0.28	4.24	9.35	2.83	20.93	4.44	6.16	6.06
Cherry	Rockport Bigarreau	33.70	5.51	0.45	2.39	16.23	2.28	25.20	4.52	3.95	5.77
	Average	33.96	6.96	0.31	4.13	13.29	2.41	22.86	4.83	5.29	5.97
Pear	Howell	24.44	3.25	0.24	3.74	16.82	1.96	37.94	4.16	2.58	4.87
Pear	Doyenne d'Ete	21.74	5.08	0.23	5.44	16.48	1.75	28.84	5.30	7.51	7.63
Pear	Flemish Beauty	35.46	6.25	0.24	4.84	3.90	2.32	30.59	3.68	2.55	10.17
	Average	27.21	4.86	0.24	4.67	12.40	2.01	32.46	4.38	4.21	7.56

AMOUNTS OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS.

		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
1......	Hurlburt roots....................	4.07	0.64	0.04	0.95	0.42	3.86	1.60	1.11	1.52
	Hurlburt trunks	0.45	0.05	0.07	0.44	0.00	5.09	0.59	0.28	0.15
	Hurlburt branches	0.11	0.20	0.03	0.16	0.03	1.83	0.13	0.22	0.23
		4.63	0.89	0.14	1.55	0.45	10.78	2.32	1.61	1.90
2......	Haas roots........................	1 80	0.63	0.02	0.34	0.29	2.22	0.62	0.32	0.36
	Haas trunks	0.10	0.30	0.02	0.37	0.00	2.19	0.46	0.07	0.34
	Haas branches	0.06	0.33	0.04	0.09	0.00	1.37	0.31	0.08	0.27
		1.96	1.26	0.08	0.80	0.29	5.78	1.39	0.47	0.97
3......	Golden Sweet roots................	1.20	0.33	0.02	0.12	0.13	1.17	0.21	0.17	0.09
	Golden Sweet trunks	0.17	0.15	0.01	0.04	0.00	1.40	0.15	0.13	0.27
	Golden Sweet branches	0.05	0.12	0.01	0.06	0.00	0.85	0.17	0.15	0.07
		1.42	0.60	0.04	0.22	0.13	3.42	0.53	0.45	0.43
4......	Yellow Spanish roots	3.94	1.05	0.03	0.70	0.27	2.76	0.65	0.90	0.67
	Yellow Spanish trunks.............	0.43	0.36	0.01	0.28	0.06	2.78	0.41	0.36	0.54
	Yellow Spanish branches...........	0.18	0.50	0.02	0.19	0.00	2.92	0.56	0.39	0.64
		4.55	1.91	0.06	1.17	0.33	8.46	1.62	1.65	1.85
5......	Napoleon Bigarreau roots..........	2.68	0.49	0.02	0.34	0.19	1.88	0.39	0.31	0.55
	Napoleon Bigarreau trunks	0.55	0.36	0.02	0.24	0.08	2.63	0.37	0.21	0.31
	Napoleon Bigarreau branches	0.09	0.28	0.01	0.21	0.00	1.86	0.30	0.25	0.22
		3.32	1.13	0.05	0.79	0.27	6.37	1.06	0.77	1.08

AMOUNTS OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS — (*Concluded*).

		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	Mg. O.	Na_2O.	K_2O.
6......	Rockport Bigarreau roots............	4.58	0.74	0.06	0.33	0.31	3.43	0.61	0.54	0.78
	Rockport Bigarreau trunks	0.33	0.26	0.02	0.21	0.03	3.39	0.41	0.36	0.58
	Rockport Bigarreau branches	0.25	0.29	0.02	0.11	0.04	3.46	0.55	0.85	0.60
		5.16	1.29	0.10	0.65	0.38	10.28	1.57	1.75	1.96
7......	Windsor roots	3.87	0.81	0.03	0.44	0.29	2.16	0.49	0.63	0.62
	Windsor trunks	0.47	0.36	0.02	0.23	0.06	2.50	0.54	0.69	0.67
	Windsor branches...................	0.48	0.61	0.04	0.26	0.15	4.53	0.71	0.45	1.07
		4.82	1.78	0.09	0.93	0.50	9.19	1.74	1.77	2.36
20......	Doyenne d'Ete roots	3.21	0.75	0.03	0.80	0.26	4.26	0.78	1.11	1.13
	Doyenne d'Ete trunks	0.56	0.79	0.04	0.45	0.02	6.57	0.82	1.20	1.33
	Doyenne d'Ete branches	0.37	0.59	0.03	0.18	0.00	3.79	0.61	0.72	0.88
		4.14	2.13	0.10	1.43	0.28	14.62	2.21	3.03	3.34
21......	Howell roots..................	0.32	0.45	0.03	0.50	0.26	5.03	0.55	0.34	0.65
	Howell trunks	0.38	0.41	0.03	0.30	0.02	4.67	0.67	0.34	0.70
	Howell branches	0.32	0.28	0.02	0.19	0.00	2.38	0.52	0.44	0.64
		1.02	1.14	0.08	0.99	0.28	12.08	1.74	1.12	1.99
23......	Flemish Beauty roots...............	1.48	0.26	0.01	0.20	0.10	1.28	0.15	0.11	0.43
	Flemish Beauty trunks	0.55	0.52	0.04	0.49	0.05	5.74	0.92	1.01	1.04
	Flemish Beauty branches	0.20	0.26	0.02	0.24	0.00	2.67	0.44	0.42	0.62
		2.23	1.04	0.07	0.93	0.15	9.69	1.51	1.54	2.09

AMOUNT OF ASH CONSTITUENTS IN EACH TREE BY WEIGHT.

		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3	CaO.	MgO.	Na_2O	K_2O.	Green weight, grams.	Total ash, grams.	Ash in one ton, lbs.
Apple	Hurlburt	4.63	0.89	0.14	1.55	0.45	10.78	2.32	1.61	1.90	1545.0	24.27	31.4
Apple	Haas	1.96	1.26	0.08	0.80	0.29	5.78	1.39	0.47	0.97	713.0	13.00	36.5
Apple	Golden Sweet	1.42	0.60	0.04	0.22	0.13	3.42	0.53	0.45	0.43	587.0	7.24	24.7
Cherry	Yellow Spanish	4.55	1.91	0.06	1.17	0.33	9.73	1.62	1.65	1.85	1558.0	22.87	29.4
Cherry	Napoleon Bigarreau	3.32	1.13	0.05	0.79	0.27	6.37	1.06	0.77	1.08	1143.0	14.84	26.8
Cherry	Rockport Bigarreau	5.16	1.29	0.10	0.65	0.38	10.28	1.57	1.75	1.96	1786.0	23.14	25.9
Cherry	Windsor	4.82	1.78	0.09	0.93	0.50	9.19	1.74	1.77	2.36	2105.0	23.18	22.0
Pear	Doyenne d'Ete	4.14	2.13	0.10	1.43	0.28	14.62	2.21	3.03	3.34	1923.0	31.28	32.5
Pear	Howell	1.02	1.14	0.08	0.99	0.28	12.08	1.74	1.12	1.99	1316.0	20.44	31.1
Pear	Flemish Beauty	2.23	1.04	0.07	0.93	0.15	9.69	1.51	1.54	2.09	1525.0	19.25	25.2
		33.25	13.17	0.81	9.46	3.06	91.94	15.69	14.16	17.97	14201.0	199.51	....
	Ash in 2,000 pounds	4.73	2.00	0.12	1.33	0.56	12.95	2.21	2.00	2.53	......	28.10	....
	Ash in eleven tons	52.0	22.0	1.3	14.6	6.2	142.5	24.3	22.0	27.8	......	309.1	....

AVERAGE RESULTS.

Average weight of green tree (32.6 oz.), grams	924.00
Average per cent of water in tree	46.27
Average per cent of dry matter in tree	53.73
Average per cent of ash in green tree	1.80
Average per cent ash in dry tree	3.35
Average per cent ash in dry roots	3.90
Average per cent ash in dry trunks	2.57
Average per cent ash in dry branches	4.17
Per cent of total ash in roots	40.20
Per cent of total ash in trunks	34.70
Per cent of total ash in branches	25.10
Per cent of total dry matter in roots	34.50
Per cent of total dry matter in trunks	45.20
Per cent of total dry matter in branches	20.20

Average weight of green trees was 924 grams. With rows four feet apart and trees one foot apart in row there would be on an acre 10,890 trees weighing 22,183 pounds or eleven tons. The average of the thirty-one trees gives 1.80 per cent of ash in the green tree, therefore there would be 399.3 pounds of ash removed by an average acre of nursery stock.

Quantitative analyses have been made of the ash of three apple trees, four cherries and three pear trees, and the average of these ten, which do not widely differ in composition, shows that, upon an average, there is taken from the soil in eleven tons of nursery stock the following mineral constituents, each having been determined except the carbonic acid of the ash:

POUNDS OF MINERAL MATTER REMOVED BY ELEVEN TONS OF NURSERY STOCK.

	Pounds.
Silicic acid	50.6
Phosphoric acid	21.4
Sulphuric acid	14.3
Chlorine	1.3
Carbonic acid*	94.9
Ferric oxide	6.1
Lime	138.6

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* The carbonic acid is estimated by difference.

	Pounds.
Magnesia	23.7
Soda	21.3
Potash	27.1
Total	399.3

For the purpose of comparison the following table is presented giving the number of pounds of the several mineral constituents removed by a ton of the grain and of the straw of each of our principal cereals, from which it will be seen that since, upon an average, it requires from three to four years to grow the crop of nursery stock, the cereals make a far greater demand upon the soil than does the growing of nursery stock, and it is a matter of common observation that the removal of a crop of trees leaves the soil in excellent condition for the growth of the cereals.

It is proposed to complete the ash analyses of the remaining portion of the trees, and also make analyses of the fruit of each variety during the next season.

IN 2,000 POUNDS OF GRAIN AND STRAW — POUNDS.

	SiO_2.	P_9O_5.	SO_2	Cl.	Fe_2O_3.	MgO.	CaO.	K_2O.	Na_3O
Wheat grain	.8	18.4	.2	.2	.3	4.9	1.3	12.5	1.3
Rye grain	1.0	18.2	1.0	.4	.4	4.6	1.6	11.5	1.7
Barley grain................	14.2	16.4	1.0	.6	.4	4.1	1.2	10.6	1.8
Oats grain	30.6	14.1	1.0	.3	.3	4.8	2.4	10.3	1.7
Maize grain.................	.6	12.7	.3	.1	.9	4.2	.8	7.7	.4
Wheat straw	74.6	5.7	2.7	2.9	.8	2.7	6.3	12.4	1.7
Rye straw	61.2	5.5	2.0	2.0	.8	3.0	8.2	16.0	2.7
Barley straw	56.3	4.7	3.9	3.9	1.5	2.5	8.0	22.5	4.3
Oats straw	51.5	4.3	3.4	8.4	1.7	4.0	7.7	21.3	6.7
Maize straw.................	31.7	9.1	5.7	5.7	2.6	6.3	11.9	38.9	1.4

THE DAIRY SCHOOL.

Under the direction of the State Dairymen's Association, a dairy school was held at the Station of ten days' duration, beginning August 24, 1891.

Prominent teachers and dairymen of the State, assisted by members of the Station staff, gave courses of lectures upon the several topics intimately associated with the dairy industry, and daily illustrations were given in the use of the separator and in churning and other details of butter-making.

The following was the programme of the course of lectures.

ORDER OF LECTURES AT THE GENEVA DAIRY SCHOOL.

The lectures to be given at the dairy school, to be held at the Agricultural Experiment Station, Geneva, N. Y., commencing August 25, 1891, was as follows:

August 25, A. M.— W. H. Gilbert, "Advantages of Dairying;" P. M., Dr. Collier, "Soils: Their Formation and Composition, and General Principles of Fertilization."

August 26, A. M.— A. R. Eastman, "Breeding for a Purpose;" P. M., Professor Roberts, "Inheritance."

August 27, A. M.— A. R. Eastman, "Management of the Dairy;" P. M., Professor Roberts, "Environment."

August 28, A. M.— W. H. Gilbert, "Care of Cattle;" P. M., Professor Roberts, "Habit."

August 29, A. M.— Dr. Collier, "Composition of Foods and Feeding Rations;" P. M., Professor Roberts, "Foods."

August 31, A. M., Dr. Van Slyke, "Chemistry of Milk, Cream, Skim Milk and Butter;" P. M., Dr. Collier, "Composition and Production of Milk."

September 1, A. M.— Dr. Van Slyke, "Physics of Milk;" P. M., George T. Powell, "Essentials in Successful Winter Dairying."

September 2, A. M.— Dr. Van Slyke, "Science Applied to Care of Milk, Methods of Creaming, etc.;" P. M., George T. Powell, "Co-operative Dairying."

September 3, A. M.— Dr. Van Slyke, "Relations of Micro-organisms to Milk, Cream and Butter;" P. M., W. H. Gilbert, "Butter-making."

September 4 — Review of the work gone over during the course.

Methods of testing milk for fat were explained by Dr. Van Slyke each morning, when milk tests were made.

Milk tests or churning of butter took place every day from 9 to 10 A. M.

Lectures began at 10 A. M., and 2 P. M. Questions and answers followed each lecture.

The attendance upon the course was limited in number, but representatives from different portions of the State and several of the neighboring States and the Province of Ontario were present, and great interest was manifested in the proceedings during the entire course by those who were so fortunate as to avail themselves of the opportunity thus afforded them for advanced instruction by competent authorities in the several branches of practical and applied science pertaining to the dairy industry.

COMMERCIAL FERTILIZERS SOLD IN NEW YORK STATE.

While it is well known that the aggregate consumption of commercial fertilizers in the State reaches large proportions, there has been no serious effort made to determine, even approximately, the extent of the sales. While the excellence of barn-yard manure is everywhere admitted, chemical manure is found to supplement it most completely, and where there is a choice of purchasing between the two, there are many who buy the latter as being the cheapest. It is believed to be of public interest to determine the amount of those sales not only, but so far as possible the character of the fertilizers sold. A circular letter was addressed to the various manufacturers doing business in this State, requesting information as to the aggregate of their sales and also the quality of the fertilizers sold, in order that information might be obtained as to the relative consumption of phosphoric acid, potash and nitrogen compounds. It is not intended, of course, to make public the details of individual business, but to secure such general information concerning this trade as would appear to be of value to both manufacturers and consumers of these products. Nearly every one of the manufacturers addressed promptly responded to the circular asking for information. A list of these manufacturers is given for the purpose of showing how exhaustive and reliable the statistics collected are, and the aggregate of the sales reported given in the table following is about 90,333:

NAMES OF FERTILIZER MANUFACTURERS WHO HAVE REPORTED THEIR SALES FOR THE YEAR ENDING NOVEMBER 1, 1891.

Allentown Manufacturing Co., Allentown, Penn.
Armour & Co., Chicago, Ill.
H. J. Baker & Brother, 215 Pearl street, New York, N. Y.

Bowker Fertilizer Co., 43 Chatham street, Boston, Mass.
Bradley Fertilizer Co., Boston, Mass.
Brown & Gilman, 10 S. Delaware avenue, Philadelphia, Penn.
E. B. Chapin, Rochester, N. Y.
Charlotte Oil and Fertilizer Co., Charlotte, N. C.
Chemical Company of Canton, Baltimore, Md.
Chesapeake Guano Co., Baltimore, Md.
Cleveland Dryer Co., Cleveland, Ohio.
E. Frank Coe, 16 Burling slip, New York, N. Y.
Peter Cooper's Glue Factory, 17 Burling slip, New York, N. Y.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.
E. A. Cross, North Parma, N. Y.
Dambmann Brothers & Co., Baltimore, Md.
L. B. Darling Fertilizer Co., Pawtucket, R. I.
J. H. Devins, Utica, N. Y.
L. Eggers' Sons, Novelty Bone Works, West Troy, N. Y.
Ellsworth, Tuthill & Co., Promised Land, Suffolk Co., N. Y.
W. S. Farmer & Co., Baltimore, Md.
Farmers' Fertilizer Co., Syracuse, N. Y.
George B. Forrester, 169 Front street, New York, N. Y.
Hallock & Duryee Fertilizer Co., Mattituck, Suffolk Co., N. Y.
Listers' Agricultural Chemical Works, Newark, N. J.
Lorentz and Rittler, Baltimore, Md.
Frederick Ludlam, 140 Maiden Lane, New York, N. Y.
Mapes Formula and Peruvian Guano Co., 158 Front street, New York, N. Y.
Michigan Carbon Works, Detroit, Mich.
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.
L. Mittenmaier, Rome, N. Y.
Moller & Co., Bone Works, Maspeth, Queens Co., N. Y.
New Process Fertilizer Co., Hart Lot, N. Y.
Northwestern Fertilizing Co., Union Stock Yards, Chicago, Ill.
Oneonta Fertilizing Co., Oneonta, N. Y.
Preston Fertilizer Co., Green Point, Kings Co., N. Y.
John S. Reese & Co., Baltimore, Md.
Rochester Fertilizer Co., 398 E. Main street, Rochester, N. Y.
Scott Fertilizer Co., Elkton, Md.
Sheldon Brothers, Weedsport, N. Y.
Springfield Fertilizer Co., Springfield, Ohio.

H. Stappenbeck, Utica, N. Y.
Sterling Oil Co., Greenport, Suffolk Co., N. Y.
Richard H. Stone, Trumansburg, N. Y.
I. P. Thomas & Son Co., 2 S. Delaware avenue, Philadelphia, Penn.
George F. Tuthill & Co., Greenport, Suffolk Co., N. Y.
Walker Fertilizer Co., Clifton Springs, N. Y.
Walker, Stratman & Co., Pittsburg, Penn.
Zell Guano Co., Baltimore, Md.

AGGREGATE AMOUNTS OF FERTILIZERS REPORTED AS SOLD IN THIS STATE DURING THE YEAR ENDING NOVEMBER 1, 1891.

	Tons.
Complete manure for spring use	37,124.433
Complete manure for fall use	23,725.650
Ammoniated superphosphates without potash, including dissolved bone, etc., for spring use	535.100
Ammoniated superphosphates without potash, including dissolved bone, etc., for fall use	347.900
Ground bone, for spring use	1,086.780
Ground bone, for fall use	834.133
Kainite, for spring use	384.500
Kainite, for fall use	213.000
Muriate of potash, for spring use	290.125
Muriate of potash, for fall use	119.625
Nitrogenous matter:	
(*a*) Ammonium sulphate, for spring use	161.000
Ammonium sulphate, for fall use	50.000
(*b*) Sodium nitrate, for spring use	107.850
Sodium nitrate, for fall use	40.250
(*c*) Blood, ammonite, etc., for spring use	178.850
Blood, ammonite, etc., for fall use	162.750
Plain superphosphates, including both dissolved bone black and S. C. acid phosphates, for spring use	1,035.300
Plain supherphosphates, including both dissolved bone black and S. C. acid phosphates for fall use	977.500
	67,374.746
Unclassified	22,958.200
Total sales reported	90,332.946

United States Department of Agriculture,
Division of Vegetable Pathology.
Washington, D. C., *April* 23, 1892.

Dr. Peter Collier, *Director N. Y. State Experiment Station, Geneva, N. Y.:*

Sir.—In compliance with your request I herewith submit a brief report of work carried on by my assistant, Mr. D. G. Fairchild, at your Station during the season of 1891. Owing to the fact that the work is still in progress it seems best to mention simply the lines of work carried on and not the details.

Respectfully.

B. T. GALLOWAY,
Chief of Division.

Outline of Work by Mr. Fairchild in 1891.

At the request and through the co-operation of a large number of nurserymen of Western New York, a series of experiments with nursery stock was planned. Stock for this experiment was contributed by various individuals and consisted of the most susceptible stocks of cherry, plum, quince, pear and apple to the total number of 9,500.

These plants were treated with the two well-known fungicides Bordeaux mixture and ammoniacal solution, with a view of ascertaining their effect on the stocks and their value as preventives of disease. These diseases were leaf-blight of pear and quince caused by the fungus *Entomosporium maculatum*, Lev.; leaf-blight of plumb and cherry caused by *Cylindrosporium padi*, Karsten; and powdery mildew of the apple caused by *Podosphaera oxycanthae* (DC) D. By.

The remarkable dry season prevented the appearance of several of the diseases and greatly retarded the appearance of others; and while various observations were thus prevented, Bordeaux mixture gave in all late treatments very encouraging results; details of this experiment, however, which was planned to cover two years are reserved for publication until its close.

In addition to the nursery experiment above outlined, an instructive experiment with plum seedlings was made upon the place of Mr. O'Brian of Geneva. This experiment, the details of which will be published in a bulletin of the department, was made to ascertain the relative value of the ammoniacal solution* and a weak Bordeaux mixture † as preventives of leaf-blight. The result showed beyond question the efficacy of the latter over the former.

In the plum orchards of T. C. Maxwell & Bros. and A. Hammond, a comparative test of six different fungicides was made with a view of ascertaining if the early application of these mixtures would prevent leaf-blight and the consequent premature fall of the leaves, caused by *Cylindrosporium padi*, Karsten. These early treatments failed and the necessity of continuing the sprayings throughout the season was thus made manifest. In this case only dilute copper solutions, such as the ammoniacal, or a weak Bordeaux mixture, should be used.

Quince leaf-blight and fruit-spot were treated in the orchard of T. C. Maxwell & Bros., with five different fungicides. These were as follows, in the proportion of 0.1 ounces of the chemical to a gallon of water (two and three-fourth ounces per twenty-five gallons); Bordeaux mixture, normal cubic acetate, chloride of lime, malachite (basic cupric carbonate) and glue mixture and potassium sulphide; Bordeaux mixture, cupric acetate, and the mixture of malachite and glue proved effective and increased the percentage of fair fruit from eighteen to thirty-five per cent over that of adjoining trees, and forty to forty-five per cent over the average of untreated trees. On the other hand potassium sulphide and chloride of lime actually seemed to *increase* the amount of fruit spot from twenty to thirty-eight per cent over that of adjoining trees, and from nine to thirty-six per cent over that of the average of eighteen untreated trees.

At Brockport a series of tests was made upon forty trees, four standard fungicides being used. Owing to the non-appearance of the disease the experiments were wholly negative.

The presence of a destructive currant cane disease was established through the kindness of Mr. John Burroughs of West Park, on the Hudson. This gentleman sent in specimens of the diseased plants and offered an opportunity of examining them at his residence. The disease has been ascertained by means of culture and inoculation experiments to be contagious, but so far, neither in the field nor in the laboratory have any reproductive bodies, or spores, made their appearance. It is to be hoped that during the coming season the affected locality may be more definitely bounded, and the means by which the parasite is transmitted from place to place be certainly ascertained. At present the disease seems to be confined to the eastern portion of the State along the Hudson river.

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* Two ounces copper carbonate dissolved in twenty-six per cent ammonia and diluted with twenty gallons of water.

† Two pounds of copper sulphate and one pound of lime in twenty gallons of water.

OUTLINE OF WORK PROPOSED FOR 1892.

It is designed the coming season to continue the treatment of nursery stock already planted in accordance with the plans already laid out, and, if possible, to bring to completion the comparative test of the two principal fungicides as preventives of the several leaf-blights and powdery mildews. In addition, 100 plats have been planted with pear seed, upon which will be tested, through the co-operation of the horticulturist of the Station, twenty-five substances, with a view of ascertaining their efficiency in preventing the destructive pear leaf-blight the first and second seasons of growth.

WASHINGTON, D. C., *April* 23, 1892.

A brief summary of the work of the several members of the staff is presented in the report of the executive committee of the board of control, and I would refer to the several reports included in this volume for the details of this work which I am sure will commend itself as being well conceived and thoroughly executed as also of practical and scientific value. Certain portions of the work performed under the personal supervision of the first assistant in the investigation with poultry; of the chemist in the investigations relating to manufacture of butter and cheese; of the acting horticulturist upon the action of fungicides and other features of the work of the Station which it seemed desirable should be placed at once in the possession of the people, have been already partially presented in the published bulletins of the Station.

I desire to acknowledge the uniform faithfulness and zeal with which the multifarious labors of the Station have been performed by the several employes of the Station in whatever work has been assigned them, since to them largely is the credit due that so much has been accomplished.

REPORT OF THE FIRST ASSISTANT.

During the past year experiments with poultry have been continued, some feeding experiments with pigs have been made, and observations upon selected varieties of sorghum continued. Also the feeding of the dairy cattle has been attended to, the rations for the different animals, including on January 1, 1892, sixteen milch cows, six heifers and seven bulls, being arranged according to the appetite, condition, age and size. The grain food has been changed at intervals to supplement the forage and coarse fodder available during the several months of the year. The foods consumed by the different animals and the total amounts of the different constituents will be found in the tables of the bulletins and those elsewhere in the annual report. The collection of data in the field experiments with applications of crude chemicals was continued.

POULTRY.

The poultry work has been a continuation of experiments in regard to the "oyster-shell question," feeding experiments with rations for laying hens containing widely differing amounts of fat, feeding experiments with skim-milk for growing chicks, and also in regard to feeding salt to laying hens. Experiments in caponizing have been continued, and breeding experiments have been commenced.

The most conclusive results that point to the availability of the carbonate of lime in oyster shells, have been arranged in the following form for a bulletin:

During the past few years considerable discussion has occurred among poultrymen in regard to the question whether oyster shells were of any use to the hen as a source of material for the egg shell.

It is generally known that the ordinary grains fed to poultry are very deficient in lime, and some have sought to supply this deficiency, under the supposition that oyster shells were insoluble, by relying solely upon some plant foods rich in lime, such as the clovers. Crushed oyster shells have been extensively fed and with good results, but it has been thought by many that they were of value solely as grit.

No satisfactory answer seems to have been made to the question and in order to obtain some definite information several experiments have been made during the past two years at this Station. Partial analyses were made of the soluble contents of the crops, gizzards and intestines of quite a number of hens, some having been fed oyster shells and some not, but only inconclusive results were obtained. The fact of considerable free acid always being present, however, indicated that the oyster shells might be dissolved.

It has generally been found difficult to keep hens laying for any length of time when so closely confined as to preclude the possibility of their obtaining food other than that intended for them, and several projected feeding trials have not been successful. During the past year, however, some feeding experiments have given such conclusive results that it is thought well to give the data in full to those interested in poultry feeding.

Six one-year-old hens (S. C. B. Leghorns) were used in these experiments. It was intended to carry on similar experiments with ducks (Pekin), but after being closely penned (not in small pens, however) the ducks would not lay well enough, and work with them was not completed.

Three hens were shut in a cleanly swept pen, having a wooden floor of matched boards, on March thirtieth, and were fed with wheat, fresh cabbage and a mixed grain containing two parts corn meal, two parts wheat bran, one part wheat middlings and one part linseed meal (o. p.). They were given all the water they would drink and a box of coarsely ground oyster shells was kept in the pen. No other grit or food was available to them, and no dust baths were used. The nest boxes were filled with "excelsior," none of which the hens ate. The droppings were removed several times each day. After ten days' confinement, as the hens continued laying it was assumed that very little, if any, of the vegetable food previously consumed could be furnishing material for eggs, and during the next ten days the eggs were saved and the shells and contents analyzed.

At the end of this first period of account, boiled eggs were also fed, and after feeding them for three days, the hens by that time having been closely confined for twenty-three days, all eggs laid were analyzed during a second period of twelve days.

The per cent of water in each food was determined at frequent intervals during the experiment and dried samples were analyzed.

The following table shows the per cent of calcium found in the ash of each food and in the eggs and the equivalent amount of carbonate of lime. In the oyster shells and the egg shells nearly all the lime present was in the form of carbonate.

	Average per cent of moisture.	Per cent of ash in fresh substance.	Per cent of ash in water-free substance.	Per cent of calcium (Ca) in ash.	Per cent $CaCO_3$
Mixed grain......	13.7	3.54	4.10	3.66 equal to	9.14
Wheat	12.9	1.86	2.13	2.36 equal to	5.90
Cabbage.........	90.5	.66	6.94	4.04 equal to	10.10
Boiled eggs	71.4	1.05	3.67	8.23 equal to	20.57
Oyster shells	......	......	......	....	94.56
Egg shells	......	......	......	....	94.34
Membranes of eggs	......	......	4.38	10.96 equal to	27.40
Eggs (interior) ...	......	.99	......	5.72 equal to	14.30

It was intended that these hens should have only rain water to drink, but through a misunderstanding spring water was given them part of the time. The actual amount of water taken by the hens at this time is not known, but the amount measured out to them, and which they could not have exceeded, gives a limit to the amount of lime that could have been obtained from this source.

This water contained in solution 358.3 parts of total solids in the million and 287.3 parts of inorganic matter; 58.2 per cent of the inorganic matter was carbonate of lime.

The results obtained during these two periods can best be shown in the following tabulated form :

Lot 1 — Oyster Shells — First Period — Ten Days — April Ninth to April Nineteenth.

FOODS.	Total substance consumed.	Water-free substance consumed.	Ash in food consumed.	Calcium (Ca) in food consumed.	Equivalent of calcium carbonate ($CaCO_3$).
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
Mixed grain	1275.7	1100.9	45.13	1.65	4.12
Wheat...............	1077.3	938.3	19.99	.47	1.18
Cabbage.............	283.5	26.9	1.87	.08	.19
Water	12760.0	4.57	3.66	.85	2.13
Total, except oyster shells..........	2636.5*	2066.1*	70.65	3.05	7.62
Oyster shells.........	99.2	......	......	......	93.80

* Exclusive of drinking water.

PRODUCTS.	Total substance.	Water-free substance.	Ash.	Calcium Ca.	Equivalent of Ca CO_3.
	Grammes.	Grammes.	Grammes,	Grammes.	Grammes.
Eggs (entire)	523.2	......	......	......	......
Shells	......	50.6	......	......	47.74
Lining membranes	......	2.7	.12	......	.03
Eggs (whole interior)	469.9	......	4.60	.26	.66

LOT 1 — OYSTER SHELLS — SECOND PERIOD — TWELVE DAYS — APRIL TWENTY-FIRST TO MAY THIRD.

FOODS.	Total substance consumed.	Water-free substance consumed.	Ash in food consumed.	Calcium (Ca) in food consumed.	Equivalent of calcium carbonate ($CaCO_3$.)
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
Mixed grain	1357.1	1171.2	48.02	1.76	4.39
Wheat	1268.6	1104.9	25.53	.56	1.39
Cabbage	340.2	32.3	2.24	.09	.23
Boiled eggs	701.6	200.7	7.37	.61	1.52
Water	15300.0	5.48	4.39	1.02	2.55
Total, except oyster shells	3667 5*	2509.1*	85.55	4.04	10.08
Oyster shells	191.4	......	......	......	180.99

PRODUCTS.	Total substance.	Water-free substance.	Ash.	Calcium (Ca).	Equivalent of Ca CO_3.
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
Eggs (entire)	966.4	......	......	......	....
Shells	......	91.8	......	......	86.60
Lining membranes	......	4.4	.19	.02	.05
Eggs (whole interior)	870.2	......	8.61	.49	1.23

During the first period the hens laid twelve eggs; one pound of eggs being produced from 3.95 lbs. of water-free food. These eggs contained calcium equal to 48.43 grammes carbonate of lime, the shells alone containing 47.74 grammes. The grain food and cabbage consumed and the drinking water given them contained altogether calcium equal to 7.62 grammes carbonate of line. The oyster shells taken by them contained 93.80 grammes carbonate of lime.

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* Exclusive of drinking water.

During the second period the hens laid twenty-one eggs, which were produced at the rate of one pound for every 2.59 lbs. of water-free food. These eggs contained calcium equal to 87.88 grammes carbonate of lime, the shells alone containing 86.6 grammes. The food consumed and drinking water given them contained calcium equal to 10.08 grammes carbonate of lime. The oyster shells taken by them contained 180.99 grammes corbonate of lime. Of the carbonate of lime contained in the eggs during the first period 40.81 grammes, over eighty-four per cent, and of that in the eggs during the second period 77.80 grammes, over eighty-six per cent, is unaccounted for except by the carbonate of lime in the oyster shells, of which 99.2 grammes were consumed during the first period and 191.4 grammes during the second.

The difference is so great that no other conclusion seems possible than that the egg shells were constructed from material supplied in large part by the oyster shells.

These hens lost in weight a total of five ounces during the first period and a total of two ounces during the second, a change in weight of little consequence and one that might have occurred at any time within a few hours.

At the same time with these feeding trials another lot of three hens was fed under exactly similar conditions except that coarsely pounded glass was given the hens instead of oyster shells. No dark colored or opaque glass was used, broken bottles, carboys and window glass furnishing the supply. An average sample of the glass contained 5.44 per cent of calcium, no trace of which, however, was soluble in nitric or hydrochloric acid or aqua regia.

These hens did not lay as well as those having oyster shells, and two became sick (feverish and unable to stand). They recovered in about two days, however, after a little alcohol and oil was given them and the glass removed from the pen. Although pounded glass has been given to hens and chicks here for two years this is the only time that any symptoms of disease have been observed to accompany its use. The trouble was probably due to the excessive amount of glass swallowed, for while the oyster shells eaten by the hens formed 4.5 and 7.1 per cent of the total water-free material, the glass formed 31.3 per cent of the total water-free material eaten by the hens in the first period, and in the second when the hens were allowed less than they wanted, 26.1 per cent. Or in the one period the hens consumed an amount of glass weighing 45.8 per cent as much as all the dry matter of the ordinary food. These hens gained in weight during the first period eleven ounces, and lost during the second period nine ounces. Although fewer eggs were laid by this lot the shells were lighter, being in the first period 8.12 per cent of the total weight of the eggs, and in the second period 6.18 per cent, while the shells of eggs laid by the lot having oyster shells formed 9.67 per cent and 9.50 per cent of the total weight of the eggs.

The egg shells contained 92.42 per cent carbonate of lime and the ash of the eggs exclusive of shell 4.96 per cent of calcium equal to 12.4 per cent of carbonate. The eggs for the first period contained 1.01 per cent and those of the second period .98 per cent of ash.

The data for these two periods are briefly stated in the following tables. Only two hens were used during the second period:

LOT 2—GLASS—FIRST PERIOD—TEN DAYS—APRIL NINTH TO APRIL NINETEENTH.

FOODS.	Total substance consumed.	Water-free substance consumed.	Ash in food consumed.	Calcium (Ca.) in food.	Equivalent of calcium carbonate ($CaCO_3$.)
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
Mixed grain..........	567.0	489.3	20.06	.73	1.83
Wheat..............	1559.2	1358.1	28.93	.68	1.71
Cabbage.............	283.5	26.9	1.87	.08	.19
Water..............	12760.0	4.57	3.66	.85	2.13
Total, except glass.	2409.7*	1874.3*	54.52	2.34	5.86
Glass...............	857.6	......	......	46.65	116.63

PRODUCTS.	Total substance.	Water-free substance.	Ash.	Calcium (Ca).	Equivalent of $CaCO_3$.
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
Eggs (entire).........	128.0	......	......	......	....
Shells...............	......	10.4	......	......	9.61
Lining membranes....	......	.6	.03	......	.01
Eggs (whole interior) .	117.0	......	1.18	.06	.15

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*Exclusive of drinking water.

LOT 2 — GLASS — SECOND PERIOD — TEN DAYS — APRIL TWENTY-THIRD TO MAY THIRD.

FOODS.	Total substance consumed.	Water-free substance consumed.	Ash in food consumed	Calcium (Ca) in food.	Equivalent of calcium carbonate. ($CaCO_3$.)
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
Mixed grain	322.3	278.1	11.40	.42	1.04
Wheat...............	460.7	401.3	8.55	.20	.50
Cabbage.	283.5	26.9	1.87	.08	.19
Boiled eggs..........	326.0	93.2	3.42	.28	.70
Water.	12760.0	4.57	3.66	.85	2.13
Total, except glass.	1392.5*	799.5*	28.90	1.83	4.56
Glass................	283.5	......	......	15.42	38.56

PRODUCTS.	Total substance.	Water-free substance.	Ash.	Calcium.	Equivalent of $CaCO_3$.
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
Eggs (entire).........	129.5	......,	......	......	.......,
Shells	......	8.0	......	......	7.39
Lining membranes ...	......	.5	.02	......	.01
Eggs (whole interior)..	121.0	......	1.17	.06	.14

It will be seen that the amount of lime calculated as carbonate, found in the eggs, exceeded that in the food and drinking water by 3.9 grammes for one period, and nearly three grammes for the other.

While the glass taken during one period contained lime the equivalent of 116.63 grammes of carbonate and during the other of 38.56 grammes, it does not appear probable that any of this was available as egg-shell material for it existed in combination with various insoluble silicates. Treatment of the finely powdered glass with the ordinary acids failed to dissolve a trace of lime, and fusion with alkaline carbonates was necessary to its estimation. Upon examination of the excrement, of which during the first period over seventy-two per cent of the air dried substance consisted of fragments of glass large enough to be easily removed by washing, a very few small rounded fragments of limestone were found which must have been swallowed by the hens previous to their close confinement and retained for from ten to twenty days. These small pebbles of limestone had been subjected to conditions which are seen to have made oyster shells available material, and it is probable that enough lime was dissolved from them or from smaller fragments, no appreciable portions of which were left in the excrement, to have supplied the three or four grammes of lime. Hens that have been allowed free access to pounded glass mixed with oyster shells, ground bone and charcoal or with either oyster shells or bone have never been observed to take such an unnecessarily large amount of "grit," and it seems not improbable that in this case they were instinctively searching for something which the glass alone failed to supply.

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* Exclusive of drinking water.

GENERAL REMARKS.

The feeding of oyster shells during the laying season, where they can be cheaply obtained, is recommended. One pound will contain lime enough for the shells of about seven dozens of eggs.

Fine gravel containing limestone will probably as well supply the deficiency of lime existing in most foods, but the use of some sharper grit with it may be of advantage.

Long or sharp splinters of glass or dry bone should be avoided. The size of particles of grit had, for hens, better be larger than that of a kernel of wheat and should be smaller than that of a kernel of corn.

An unlimited supply of pounded glass has been attended with no bad result when the food and other grit available to the fowls contained an abundance of lime, but, when the food was deficient in lime and no other grit was attainable, hens ate an injuriously large amount of glass.

SKIM-MILK FOR GROWING CHICKS.

During the past year quite a number of chicks were grown to maturity at this Station with no drink other than skim-milk being given them, excepting not more than three or four days when skim-milk was not available and water was supplied. No water was accessible to them except as dew, or that to be found for a few hours after a rain. These chicks were raised by the ordinary method of keeping them with a hen in a small coop, the chicks being allowed to run at will over the grass in a young apple orchard. No sickly chicks were at any time noticed among them, the few lost when young being from accident and from lice getting among one brood. The growth of feathers was much more rapid and full than usual, and this was especially noticeable in the case of Light Brahma chicks.

In order to obtain information as to the cost of growing chicks by the methods in general use on farms, where skim-milk can be obtained, two lots of chicks were grown in pens. The pens were 10x12 feet, having a tight wooden floor. The open yards connecting with them, and which were deeply covered with coal ashes, were 11x20 feet. A hen was kept with each pen of chicks until they were pretty well feathered — with one pen seven and one-half weeks and the other five and one-half weeks. The chicks were of several breeds and crosses — B. Minorca, W. P. Rock-Light Brahma, Indian Game Cochin, cross; P. Rock-Minorca, cross. They were from one to three days old at commencement of feeding experiment, and the total cost of food from hatching until this time was less than one cent for each lot. During most of the experiment fourteen chicks were in one pen and sixteen in the other. More chicks were put in at the start, but the visit of a rat reduced the number. The chicks and hens were weighed once a week.

No green food was fed to one pen until the chicks were about six weeks old, and not to the other pen until eleven and one-half weeks old. The skim-milk, of which they had most of the time an abundant supply, was usually sweet. One pen (No. 11) was without milk for eight days (from Sept. 17 to Sept. 25), when water was substituted, and during this time they made a smaller gain for the food consumed than at any other.

The results averaged for periods of one and two weeks are given in the following tables:

PEN NO. 10 — HEN AND CHICKS.

Number of chicks.	Number of days.	PERIOD.	Average age of chicks.	Average weight per chick at end of period.	Gain in weight of chicks.	Gain in weight of hen.	Mixed grain, average per day.	Wheat, average per day.	Skim-milk, average per day.	Clover forage, average per day.	Total food average per day.	Total water-free food per day.	Water-free food for 1 pound gain live weight of chicks.	Cost of food per day.	Water-free food consumed per day for each pound live weight hen and chicks.	Water-free food consumed per day for each pound live weight chicks.	Cost of food for 1 pound gain in live weight.
			Days.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Lbs.	Cts.	Oz.	Oz.	Cts.
18..	9	June 8 to June 17	10	3.35	32	4	8.9	....	29.8	....	38.7	10.9	3.06	1.00	1.45	....	4.50
14..	15	June 17 to July 2...............	25	8.2	68	10	10.6	3.7	29.0	....	43.3	15.6	3.43	1.48	1.52	....	5.22
14..	14	July 2 to July 16...............	39	15.0	95	6	16.6	4.5	44.6	....	65.7	23.1	3.40	2.16	1.46	....	5.71
14..	14	July 16 to July 30..............	53	24.6	134	18	19.4	10.0	55.2	....	84.6	31.4	3.28	3.07	1.32	....	5.13
14..	7	July 30 to August 6	60	28.6	56	......	17.6	13.6	43.6	....	74.8	31.7	3.96	3.16	....	1.36	6.31
14..	14	August 6 to August 20...	74	38.6	140	......	18.6	13.2	48.0	....	79.8	32.8	3.28	3.24	....	1.12	5.19
14..	7	August 20 to August 27.......	81	43.9	74	......	20.0	15.9	58.9	....	94.8	37.4	3.54	3.76	....	1.04	5.70
13*.	14	August 27 to September 10...	95	56.0	164	......	18.2	20.6	56.8	2.0	97.6	40.3	3.44	4.12	....	1.01	5.63

* One cockerel removed for caponizing.

PEN NO. 11 — HEN AND CHICKS.

Number of chicks.	Number of days.	PERIOD.	Average age of chicks.	Average weight per chick at end of period.	Gain in weight of chicks.	Gain in weight of hen.	Mixed grain, average per day.	Wheat, average per day.	Skimmed milk, average per day.	Meat scraps, average per day.	Clover forage, average per day.	Total food per day.	Total water-free food per day.	Water-free food for 1 pound gain in weight of chicks.	Cost of food per day.	Water-free food consumed per day for each pound live weight of hen and chicks.	Water-free food consumed per day for each pound live weight chicks.	Cost of food for 1 pound gain live weight of chicks.
			Days.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Lbs.	Cents.	Oz.	Oz.	Cents.
17..	17	July 20 to August 6....................	19	4.6	56	10	5.9	3.7	18.9	1.0	......	29.5	11.3	3.63	1.20	1.57	....	6.13
16..	14	August 6 to August 20	33	10.6	85	13	7.6	6.7	28.7	2.4	......	45.4	17.8	2.94	1.99	1.48	....	5.23
16..	7	August 20 to August 27	40	13.1	49	6	9.3	7.0	44.1	3.0	......	63.4	21.6	3.08	2.44	1.28	....	5.59
16..	14	August 27 to September 10	54	21.9	140	....	12.3	13.2	36.4	2.6	.5	65.0	28.6	2.86	3.08	....	1.63	4.92
16..	14	September 10 to September 24........	68	28.4	104	....	17.8	13.7	18.2	2.0	.5	52.2	31.4	4.22	3.09	....	1.25	6.66
16..	14	September 24 to October 8............	82	38.6	163	....	16.9	17.0	50.9	2.1	3.0	89.9	37.7	3.23	3.92	....	1.12	5.38
16..	7	October 8 to October 15................	89	43.5	79	....	24.0	15.9	50.9	3.0	3.0	96.8	43.6	3.86	4.37	....	1.06	6.15

The mixed grain was composed of two parts corn meal, two parts wheat bran, one part wheat middlings and one part linseed meal, and is calculated at twenty dollars per ton. The wheat is rated at one dollar per bushel, the skim-milk at twenty-five cents per hundred pounds, the clover forage at two dollars per ton, and meat scraps at two and one-half cents per pound.

With one pen the average cost of food for every pound increase in weight during the whole time was 5.66 cents. For the other the cost of increase for all but the last two weeks was 5.36 cents and during these two weeks 5.63 cents. The cost per pound gain in weight for each period will be found in the tables. In one pen chicks averaging 2.4 pounds weight at 10½ weeks of age were grown at a cost for food of 5.31 cents per pound, or an average of 12.7 cents apiece. In the other pen chicks averaging 2.4 pounds at 11¾ weeks of age cost for food 5.36 cents per pound, or 12.9 cents apiece. This cost of production of course includes the cost of feeding the hen during the first few weeks. These results are not so good as are those sometimes reported by incubator manufacturers, but they are obtained by methods that are well understood and in use among farmers. Although these chicks were rather closely confined they were kept freer from lice than, unfortunately, are the chicks as a rule on farms.

Under ordinary conditions, chicks ought to be hatched, making a fair allowance for value of eggs and food for sitting hens, at a cost of less than five cents apiece. The highest cost per pound gain during any week, while growing chicks to three and one-half pounds average weight, was less than seven cents, and the cost averaged much less than six cents. At the prices generally obtained for chicks of this and lesser weights, the growth was certainly a profitable one. With chicks having the liberty of the fields it seems reasonable to expect a still cheaper production of meat, and it would appear that a profitable use for some of the skim-milk of the farm would be in the growing of chicks for home use or for the market.

An unlimited supply of sweet skim-milk can apparently be given to chickens with advantage, but sour milk must be fed with caution. Where sour milk only is available it is best to coagulate thoroughly by moderate heating, and feed only the curd, straining out as much of the whey as possible.

FEEDING TALLOW TO HENS.

In order to observe the effect of feeding more than an average amount of fat in a ration, two pens of hens were fed for a few months, one having as much tallow as was readily eaten with a moderate grain ration, and the other having a similar ration with linseed meal (o. p.) substituted for the tallow.

This feeding trial was not begun until March third, and although it extended over the larger part of the ordinary laying season it did not include the whole. From May fifth to October sixth, during the latter five months, eight hens were in each pen and, for the two months preceding, fewer (six, five and four). The fowls were S. C. B. Leghorns with the exception of two of Game-Wyandotte cross in each pen. There was fed, besides tallow and linseed meal, wheat, corn silage, cabbage, alfalfa forage, timothy forage and two grain mixtures. Mixture No. 10 contained six parts wheat bran, three parts wheat middlings and one part linseed meal. Mixture No. 16 contained six parts wheat bran, three parts corn meal, two parts linseed meal. The results are averaged in the tabular statement for irregular periods, consisting of from twenty-one to forty-eight days, according to the green foods, etc., available.

Although there was a constant and considerable difference between the two rations, neither ration was an extreme. The ratio of total protein to the total carbohydrates was, on the average for the seven months, 1 : 4.47 in the linseed meal ration, and 1 : 5.53 in the tallow ration. With the weight of fats multiplied as usual the average ratios were 1 : 4.78 and 1 : 6.75. The proportion of fats to the total water-free food showed, however, greater difference, in the one ration being that of 1 : 29.5 and in the other 1 : 8.1.

The average egg product was somewhat in favor of the hens having the less fat in their food, and the average size of the eggs laid by them was a little larger. During one period, however, of forty-two days in July and August more eggs were obtained from the hens having tallow. During the first period while the hens were newly confined there were few eggs laid, and during the latter period many hens were molting.

The greatest difference observed was that the hens having the linseed meal molted nearly all at the same time, earlier in the season and more rapidly. Only few of the hens which had been fed tallow had begun to molt at the close of this feeding trial, October sixth, by which time several hens from the other pen were in new plumage. The tallow ration was apparently too deficient in nitrogen to encourage the growth of new feathers, and the results are in support of the advice to feed during the summer a highly nitrogenous ration to help early molting.

The amount of tallow fed was not enough to affect the health of the fowls, and they were throughout in better apparent condition than those of the other pen. The average weight of the tallow-fed hens was but slightly the greater.

The average data for these two pens are given in the following tabulated form :

LOT A — LESS FAT.

Number of fowls.	Days in period.	PERIOD.	Average live weight at beginning.		Average live weight at end.		Average gain or loss in weight.	AVERAGE PER DAY PER FOWL.						
								Water-free mixed grain No. 10.	Water-free mixed grain No. 16.	Water-free wheat.	Water-free linseed meal.	Water-free silage.	Water-free cabbage.	Water-free alfalfa.
			Lbs.	Oz.	Lbs.	Oz.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
6	27	March 3 to March 30	3	3.8	3	12.8	+ 9.0	.89	....	2.04	.14	.06	....	....
4	37	March 30 to May 5.........	3	12.0	2	15.2	—12.8	.55	....	1.33	.20	.03	.04	....
8	21	May 5 to May 26	2	13 6	2	14.4	+ .8	.68	....	1.19	.11	.05	....	....
8	42	May 26 to July 7	2	14.4	2	10.0	— 4.4	....	.73	1.58	.20	.01	Timothy forage.	.09
8	42	July 7 to August 19	2	10.0	2	12.5	+ 2.5	....	.40	1.35	.20	....	....	.13
8	48	August 19 to October 6....	2	12.5	3	2.6	+ 6.1	....	.63	1.45	.21	....	.04	.03

LOT A — LESS FAT — (*Continued*).

Number of fowls.	Days in period.	PERIODS.	AVERAGE PER DAY PER FOWL.					Ratio of proteine to total carbohydrates.	Ratio of protein to carbehydrates with fats ×2½.	TOTAL PER FOWL.		Pounds of water-free food to produce one lb. of eggs.
			Total fresh and air dry food.	Total water-free food.	Total proteine in food.	Total nitrogen-free extract in food.	Total fat in food.			EGGS. Number.	EGGS. Weight.	
			Ounces.	Ounces.	Ounces.	Ounces.	Ounces.				Ounces.	Lbs.
6	27	March 3 to March 30	3.81	3.13	.493	2.280	.094	1:4.8	1:5.1	3.50	5.94	14.23
4	37	March 30 to May 5.........	2.99	2.15	.363	1.521	.070	1:4.4	1:4.7	16.75	29.29	2.72
8	21	May 5 to May 26...........	2.47	2.03	.328	1.451	.064	1:4.6	1:4.9	7.13	11.83	3.56
8	42	May 26 to July 7...........	3.28	2.61	.443	1.822	.097	1:4.3	1:4.7	22.00	36.74	2.96
8	42	July 7 to August 19........	2.79	2.08	.357	1.446	.075	1:4.3	1:4.6	9.25	16.22	5.48
8	48	August 19 to October 6....	2.91	2.36	.399	1.654	.086	1:4.4	1:4.7	4.52	8.34	13.58

LOT B — MORE FAT.

Number of fowls.	Days in period.	PERIOD.	Average live weight at beginning.		Average live weight at end.		Average gain or loss in weight.	Average Per Day Per Fowl.						
								Water-free mixed grain No. 10.	Water-free mixed grain No. 16.	Water-free wheat.	Water-free tallow.	Water-free silage.	Water-free cabbage.	Water-free-alfalfa.
			Lbs.	Oz.	Lbs.	Oz.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
6	27	March 3 to March 30	3	1.7	3	13.8	+12.1	.94	....	2.21	.16	.06	....	....
5	37	March 30 May 5	4	0.0	2	15.8	—18.0	.72	....	1.10	.19	.02	.04	....
8	21	May 5 to May 26	2	15.3	3	0.1	+ .8	.58	....	1.03	.23	.05	....	....
8	42	May 26 to July 7	3	0.1	3	2.3	+ 2.2	....	.62	1.45	.24	.02	Timothy forage.	.08
8	42	July 7 to August 19	3	2.3	3	0.0	— 2.3	....	.97	1.40	.25	....	....	.12
8	48	August 19 to October 6	3	0.0	3	3.4	+ 3.4	....	.26	1.16	.24	....	.04	.02

LOT B — MORE FAT — (*Concluded*).

Number of fowls.	Days in period.	PERIOD.	AVERAGE PER DAY PER FOWL.					Ratio of proteine to total carbohydrates.	Ratio of proteine to carbohydrates with fats. ×2½.	TOTAL PER FOWL.		Pounds of water-free food to produce one lb. of eggs.
			Total fresh and air dry food.	Total water-free food.	Total proteine in food.	Total nitrogen-free extract in food.	Total fats in food.			EGGS.		
										Number.	Weight.	
			Ounces.	Ounces.	Ounces.	Ounces.	Ounces				Ounces.	Lbs.
6	27	March 3 to March 30	4.07	3.37	.478	2.389	.240	1:5.5	1:6.3	4.67	8.17	11.13
5	37	March 30 to May 5	2.77	2.07	.295	1.365	.233	1:5.4	1:6.6	14.60	25.50	3.00
8	21	May 5 to May 26...........	2.33	1.89	.254	1.217	.266	1:5.8	1:7.4	4.75	7.71	5.15
8	42	May 26 to July 7...........	3.04	2.41	.338	1.573	.300	1:5.5	1:6.9	14.63	24.76	4.08
8	42	July 7 to August 19	3.46	2.86	.404	1.752	.325	1:5.1	1:6.4	15.00	20.41	5.01
8	48	August 19 to October 6....	2.12	1.72	.228	1.106	.269	1:6.0	1:7.8	5.75	10.28	8.00

FEEDING SALT TO HENS.

Salt has generally been fed to hens at this Station, although in small quantities, and no injurious results have been observed to accompany its use. A short trial was made with some two-year-old hens to get indications of the amount possible to feed without injury. Six hens (two Brahmas, two Cochins and two Game crosses in each pen) were confined August twenty-seventh in each of two small pens, 5x8 feet, having yards attached 5x28 feet. They were fed similar rations, consisting of a mixed grain, wheat and grass, and plenty of water was allowed them. The mixed grain contained five parts corn meal, five parts wheat bran, three parts linseed meal (N. P.) and two parts wheat middlings.

Those of one pen were fed salt in their food at the rate per day for each fowl of .021 ounces during the first thirteen days, then for nineteen days .042 ounces per day, and then during nine days .063 ounces per day. After this the amount was reduced to .042 ounces per day and continued for twenty days. This salt the hens were obliged to eat, for it was mixed in their food. Until the amount of .063 ounces per day for each hen was fed (at the rate of 6.3 ounces, nearly one-half pint, a day for 100 hens) no bad effects were observed. This amount, however, was sufficient to cause diarrhoea in two of the hens. Upon reducing the amount of salt to .042 ounces per hen the trouble disappeared without other treatment.

After these hens had been confined two months (on October twenty-seventh), one pen having had no salt whatever and the other all that was consistent with good health, a shallow box of salt (five pounds) was placed on the floor of each pen. After this, salt was no longer mixed with the food but the box of salt was kept in each pen for a month. Although the salt was picked over a little by the hens, not enough was eaten to injure the health of any, and the trial was carried no further.

The total gain in weight per fowl during the first two months was for those having salt, 8.2 ounces and for the others 10.5 ounces. During the last month it was for those having had salt an average of 2.8 ounces, and for the others 8.7 ounces. The total grain food consumed per day was for the salt-fed pen 4.17 ounces per fowl during first two months and

4.28 ounces during the last month. For the other pen the average was 3.40 ounces per day for the two months and 4.13 ounces for the last month. During the first two months ninety-four eggs were obtained from the pen having salt, and during the last month but one egg; while forty-seven eggs were obtained from the other pen during the two months and fourteen during the last month. The number of eggs laid during this trial is of not great significance, as it was about the end of the laying season and the hens were old; but inasmuch as the yield of eggs was twice as great from the hens having salt, while it was mixed in the food, it would appear that not enough was fed to very injuriously affect egg production.

The salt used was ordinary barrel-salt, although not coarse. Should rock salt be exposed or salt that contained large crystals or fragments as large as the particles of gravel and grit eaten by hens it would, of course, not take long for a fatal amount to be swallowed. For mature fowls it is probable that salt at the rate of one ounce per day for 100 fowls could, under ordinary conditions, be fed without injury.

PRESERVING EGGS.

As many inquiries have been made in regard to keeping eggs, several methods which are often recommended have been tried at this Station. Many methods of dry packing have proved very unreliable, and the only eggs that have been preserved at all well by dry packing have been those kept in common salt. Eggs to be packed in salt were first wiped with a rag greased with vaseline, to which had been added a small amount of either salicylic acid or boracic acid. A serious disadvantage of keeping eggs in salt, is that the yelks quite often become coagulated or hardened.

The method most generally employed where cold storage is not available is that of preserving in a solution of lime and salt, and this is probably the most successful method in use. A solution which has given very excellent results can be made as follows:

Mix four quarts of fine slacked lime and one quart of common salt in five gallons of water. Stir thoroughly several times, and after all is dissolved that is possible (better to let stand for day and half), decant the clear liquid into a glazed earthenware or wooden vessel. Then add one-half ounce of boracic acid. The eggs are put in the solution, and it is well to keep the liquid at the depth of three inches above the eggs. The jars or tubs of eggs should be kept in a cool place, and not disturbed until the eggs are taken out for use.

It is recommended by some to also cover the eggs with a cloth on top of which is spread some of the sediment from the mixture, but this is unnecessary. Quite a number of eggs were opened in November, December and January, after having been thus kept for six and seven months, and none having perfect shells were spoiled. Eggs having imperfect shells will, of course, be spoiled in this solution.

It is always essential to have eggs with a clean and perfect shell, and absolutely fresh, if they are to be preserved.

SWINE.

Several feeding experiments with pigs have been made during the year. A bulletin giving most of the results obtained with coarse foods was published in April. Quite a number of feeding trials not reported, in which it was desired to observe the effect of an addition of salt to the food, are complete enough that the results can be here given.

In the one experiment only a small amount of silage and coarse forage was fed, the proportion varying from ten to sixteen per cent of the total water-free food. Two pens of pigs, as near alike as possible in age, size and previous treatment, were always fed at the same time. The pen which had salt during one period was without during the next and vice versa. The mixed grain A contained one part by weight of "Patent Process Feed" (a gluten meal) and three parts of corn meal, and the mixed grain B contained one part of "Patent Process Feed" and six parts corn meal.

Except during one short period when there was a very slight difference in favor of the ration without salt (one-tenth of one cent less cost per pound gain) the results were always considerably in favor of the ration to which a small amount of salt was added. The general results of this feeding experiment calculated to the rate per 100 pounds live weight and averaged for periods according to the slight changes of food, are found in the following table:

AVERAGE PER DAY FOR EVERY 100 POUNDS OF LIVE WEIGHT.

Period.	PIGS.	Salt.	Total mixed grain (A).	Total mixed grain (B).	Total silage.	Total comfrey.	Total food.	Water.	Water-free mixed grain (A).	Water-free mixed grain (B).	Water-free silage.	Water-free comfrey.	Total water-free food.	Gain in weight.	Pounds of water-free food to produce one pound gain.
		Ozs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
June 1 to June 22 ..	Five Duroc Jerseys, average weight during period 118.5 pounds	.17	1.68	......	1.18	......	2.86	6.79	1.49	......	.29	......	1.78	.57	3.12
June 1 to June 22 ..	Five Duroc Jerseys, average weight during period 121.1 pounds	0.	1.64	......	1.15	......	2.79	6.69	1.45	......	.29	......	1.74	.54	3.22
June 22 to July 13 ..	Five Duroc Jerseys, average weight during period 133.1 pounds..................	.15	1.98	......	......	1.05	3.03	7.27	1.54	......	......	.23	1.77	.54	3.28
June 22 to July 13 ..	Five Duroc Jerseys, average weight during period 135.2 pounds..................	0.	1.92	......	......	1.04	2.96	6.94	1.70	......	......	.23	1.93	.51	3.78
July 13 to August 3.	Five Duroc Jerseys, average weight during period 151.7 pounds..................	.20	......	1.96	.92	......	2.88	5.64	......	1.75	.23	......	1.98	.58	3.41
July 13 to August 3.	Five Duroc Jerseys, average weight during period 150.1 pounds	0.	......	1.98	.93	......	2.91	5.28	......	1.77	.23	......	2.00	.60	3.33

AVERAGE PER DAY FOR EVERY 100 POUNDS LIVE WEIGHT.

Period.	PIGS.	Salt.	Total corn meal.	Total silage.	Total barley and pea forage.	Total food.	Water.	Water-free corn meal.	Water-free silage.	Water-free barley and pea forage.	Total water-free food.	Gain in weight.	Pounds of water-free food to produce one pound gain.
		Ozs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Aug. 3 to Aug. 24...	Five Duroc Jerseys, average weight during period, 168.5 pounds..........................	.24	1.95	.83	......	2.78	5.20	1.75	.21	......	1.96	.50	3.92
Aug. 3 to Aug. 24...	Five Duroc Jerseys, average weight during period, 168.7 pounds..........................	......	1.95	.83	......	2.78	4.54	1.75	.21	......	1.96	.43	4.56
Aug. 24 to Sept. 21..	Five Duroc Jerseys, average weight during period, 190.7 pounds.......	.21	1.91	......	.73	2.64	4.26	1.72	......	.19	1.91	.54	3.54
Aug. 24 to Sept. 21.	Five Duroc Jerseys, average weight during period, 188.4 pounds..........................	......	1.93	......	.74	2.67	3.67	1.73	......	.19	1.92	.42	4.57

The gain made during this experiment was a profitable one even with prices of grain somewhat higher than usual. The average cost, however, for all the periods was forty-eight cents less per 100 pounds gain with the pigs having salt.

While the results have generally favored the addition of salt to the ration when only a small proportion of the coarser foods was used, they have not tended always in the same direction when a large proportion was fed. While feeding clover, corn silage, sorghum, etc., better results have generally attended the ration to which salt has been added, but whenever mangolds have been fed the pigs having salt have generally made much poorer gains. This may perhaps be due to the fact that as a much larger amount of salt exists in mangolds than in most other foods, the salt added is enough to make an injurious quantity. Results of experiments where coarse foods were used were given in the annual report for 1890, and in bulletin No. 28. The results of several feeding trials, made in this connection, which have not been reported, are given briefly in the following tabulated form.

Other feeding trials made during the year are part of experiments not completed.

AVERAGE PER DAY FOR EACH 100 POUNDS, LIVE WEIGHT.

Period.	PIGS.	Salt.	Total linseed meal	Total mangolds.	Total food.	Water.	Water-free linseed meal.	Water-free mangolds.	Total water-free food.	Gain in weight.	Pounds of water-free food for one pound gain.
		Ozs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Jan. 23 to Feb. 13...	Three Cheshires, average weight during period, 141.3 pounds	.12	.47	9.32	9.79	5.67	.41	1.01	1.42	.16	8.87
Jan. 23 to Feb. 13...	Two Cheshires, average weight during period, 150.0 pounds	......	.57	8.71	9.28	3.69	.50	.94	1.44	.37	3.89
Feb. 13 to Mar. 20...	Two Cheshires, average weight during period, 170 pounds	.15	.59	13.07	13.66	4.35	.52	1.41	1.93	.33	5.85
Feb. 13 to Mar. 20...	Two Cheshires, average weight during period, 167 pounds	......	.60	13.30	13.90	4.20	.52	1.44	1.96	.38	5.15
Feb. 2 to Mar. 2.....	Five Duroc Jerseys, average weight during period, 80 pounds.........	.12	.41	16.25	16.66	.69	.36	1.75	2.11	.58	3.64
Feb. 2 to Mar. 2.....	Five Duroc Jerseys, average weight during period, 80.4 pounds.........	......	.41	16.16	16.57	.92	.36	1.74	2.10	.53	3.96
Mar. 2 to Mar. 23 ...	Five Duroc Jerseys, average weight during period, 90 pounds.........	.11	.65	16.30	16.95	.77	.57	1.76	2.33	.36	6.47
Mar. 2 to Mar. 23 ...	Five Duroc Jerseys, average weight during period, 92 pounds.........	......	.64	15.84	16.48	1.12	.56	1.71	2.27	.58	3.91

AVERAGE PER DAY FOR EACH 100 POUNDS, LIVE WEIGHT.

Period.	PIGS.	Salt.	Total linseed meal.	Total gluten feed.	Total corn silage.	Total food.	Water.	Water-free linseed meal.	Water-free gluten feed.	Water-free corn silage.	Total water-free food.	Gain in weight.	Pounds of water-free food for one pound gain in weight.
		Ozs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
March 30 to April 20	Five Duroc Jerseys, average weight during period, 98.4 pounds	.10	.37	......	7.66	8.03	3.26	.32	......	1.52	1.84	.25	7.36
March 30 to April 20	Five Duroc Jerseys, average weight during period, 94 pounds	......	.40	......	8.02	8.42	2.78	.35	......	1.60	1.95	.18	10.83
April 20 to May 25.........	Five Duroc Jerseys, average weight during period, 108 pounds.............	.10	......	.71	9.16	9.87	4.56	....	.64	1.82	2.46	.37	6.65
April 20 to May 25.........	Five Duroc Jerseys, average weight during period, 103.6 pounds.................	......	......	.74	9.55	10.29	3.55	....	.66	1.90	2.56	.43	5.95

SORGHUM.

Sixteen varieties of sorghum were grown in 1891. Ten of them were from seed selected from individual canes in 1890, and four other varieties from seed received from the Department of Agriculture, Washington.

The unusually dry weather early in the summer delayed the sprouting of the seed several weeks and several varieties that generally ripen early failed to mature before frost. The average of observations on several rows of each variety will be found in the following table. The average height given does not include the panicle. The average weight is that of the stripped cane. It is not possible to estimate any yield of seed on account of English sparrows. No. 35 is valuable for seed alone, and the only varieties recommended for syrup in New York State are Nos. 6, 8, 9, 10, 11 and 72, but for forage any of the varieties on the list could be successfully grown.

OBSERVATIONS ON VARIETIES OF SORGHUM GROWN IN 1891.

Row number.	NAME OF VARIETY, ETC.	Seed planted.	Maturity.			Average height.	Average diameter.	Average weight.
			Panicle first appeared.	Panicle in bloom.	Seed ripe.	Ft.	In.	Ozs.
3	Sport from White African, 1890 seed	May 9	August 21	September 2	October 10	8.4	.8	19.4
6	Black Sorghum	May 9	August 21	September 2	October 12	7.9	.7	19.5
7	Undendebule	May 9	September 14	September 24	....	9.4	1.0	24.0
8	Jyangentombi (not true), 1890 seed	May 9	August 26	September 9	October 9	9.6	.9	23.9
9	Boomvana or Early Amber, 1890	May 9	August 12	August 27	October 4	7.4	.6	16.6
10	Koombana, 1890 seed	May 9	August 17	August 28	October 7	7.5	.7	17.2
11	Pootung Sorghum, 1890 seed	May 9	August 20	September 2	October 9	8.5	1.0	24.3
20	Ubehlana, 1890 seed	May 9	September 25	August 7	....	8.3	1.0	30.2
72	Early variety from S. H. Kenney, 1890 seed	May 9	August 14	August 30	October 9	7.7	.7	15.4
9, mixed	Early Amber, 1890	May 9	August 28	August 27	October 3	7.3	.6	16.6
Sport 20	Sport from Unbehlana, 1890	May 9	August 25	August 20	....	13.4	1.1	27.0
21	"D. of A. Early Orange (Sugar, 16.07)"	May 9	September 12	September 26	....	7.7	1.3	40.2
23	"Folger's Early D. of A. (Sugar, 17.50)"	May 9	August 29	September 10	....	8.8	.8	22.0
24	"Amber D. of A. (Sugar, 16.00)"	May 9	August 22	September 10	....	8.7	.9	24.7
25	"Coleman Cane, D. of A. (Sugar, 15.40)"	May 9	September 9	September 20	....	7.2	1.1	31.1
27	"Undendebule, No. 1 (Sugar, 17.70)"	May 9	September 20	September 26	....	9.1	1.1	30.5
28	"Links Hybrid, D. of A. (Sugar, 15 15)"	May 9	....	September 27	....	9.3	1.1	31.5
30	"Sorghum Ruber" (from Java)	May 9	September 1	September 18	....	6.8	.9	13.5
35	"Jerusalem Corn"	May 13	August 9	August 22	September 27	4.6	.6	.....

In 1890 sorghum grown on strips of land that had been top-dressed with carbonate of lime averaged considerably higher in content of sugar than that from land not so treated. As only forty canes were analyzed in the experiment of that season, the work was repeated this year on a somewhat larger scale. Four plats, A, B, C and D, were planted, each with the same number of varieties in rows, and plats A and C received an application of crude precipitated carbonate of lime at the rate of 6,000 pounds per acre, B and D being left blank. No differences of any consequence in yield or maturity were noticeable. In the fall partial analyses were made of the juices from ninety-four individual canes from these plats, one-half from the limed plats and the other half of like maturity and of the same varieties from the blank plats. The average of all the determinations from plats A and C was: Specific gravity of juice, 1.0593, and cane sugar 9.36 per cent; and from plats B and D: Specific gravity, 1.0592; cane sugar, 9.39 per cent. From these results it is quite plain that for this season at least there was no advantage in favor of an application of carbonate of lime. It may be that on a heavier clay soil an application of carbonate of lime will show more benefit, but on such a soil it is not recommended to grow sorghum except for forage.

The variations of juices from canes of the several varieties will be found in the following table:

JUICES OF SORGHUMS, 1891.

Row No.	NAME OF VARIETY, ETC.	Date of analysis.	Weight of cane. Ounces.	Per cent of juice obtained.	Sp. gr. of juice.	Per cent of sugar by polarization.	Maturity of seed.
3	Sport from White African, 1890 seed	October 13	17.5	62.9	1.044	5.91	Ripe seed.
3	Sport from White African, 1890 seed	October 13	16.3	65.2	1.040	4.58	Ripe seed.
3	Sport from White African, 1890 seed ...	October 13	16.8	65.4	1.035	2.84	Ripe seed.
3	Sport from White African, 1890 seed ...	October 13	20.8	67.5	1.048	6.52	In hard dough.
3	Sport from White African, 1890 seed	October 15	18.0	66.3	1.038	3.89	Ripe seed.
3	Sport from White African, 1890 seed ...	October 15	17.8	65.4	1.048	6.78	Ripe seed.
3	Sport from White African, 1890 seed	October 15	19.0	64.6	1.042	4.94	Ripe seed.
3	Sport from White African, 1890 seed	October 15	18.0	67.7	1.046	6.60	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 13	17.3	73.6	1.054	9.27	In soft dough.
6	Black sorghum variety, bicolor, 1890 seed	October 13	17.0	70.6	1.061	10.51	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 13	19.3	67.5	1.046	7.09	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 13	19.0	73.7	1.059	10.18	In hard dough.
6	Black sorghum variety, bicolor, 1890 seed	October 16	12.3	57.1	1.023	1.28	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 16	18.8	70.7	1.054	8.50	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 16	21.0	68.1	1.064	11.10	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 16	22.8	68.1	1.057	9.88	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 23	22.5	65.6	1.061	10.62	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 23	21.3	65.7	1.060	10.12	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 23	18.8	62.4	1.064	10.78	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 23	23.8	71.6	1.034	3.26	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 24	17.0	68.8	1.032	3.63	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 24	18.5	67.5	1.050	7.36	Ripe seed.
6	Black sorghum variety, bicolor, 1890 seed	October 24	17.8	67.6	1.035	4.02	Ripe seed.
6	Black sorghum variety, bicolor, 1800 seed	October 24	19.0	70.8	1.053	7.91	Ripe seed.

JUICES OF SORGHUMS, 1891 — (*Continued*).

Row No.	NAME OF VARIETY, ETC.	Date of analysis.	Weight of cane. Ounces.	Per cent of juice obtained.	Sp. gr. of juice.	Per cent of sugar by polarization.	Maturity of seed.
7	Undendebule, 1890 seed	October 14	21.5	71.4	1.071	13.03	In soft dough.
7	Undendebule, 1890 seed	October 14	36.3	68.8	1.073	12.69	In soft dough.
7	Undendebule, 1890 seed	October 14	33.0	62.9	1.072	12.95	In soft dough.
7	Undendebule, 1890 seed	October 14	37.8	64.9	1.058	10.35	In soft dough.
8	"Jyangentombi" (not true), 1890 seed	October 14	24.5	55.6	1.074	13.12	Ripe seed.
8	"Jyangentombi" (not true), 1890 seed	October 14	31.0	57.3	1.067	11.18	Ripe seed.
8	"Jyangentombi" (not true), 1890 seed	October 14	22.8	59.1	1.068	12.24	Ripe seed.
8	"Jyangentombi" (not true), 1890 seed	October 14	24.0	55.2	1.072	12.95	Ripe seed.
8	"Jyangentombi" (not true), 1890 seed	October 16	26.0	55.8	1.064	9.31	Ripe seed.
8	"Jyangentombi" (not true), 1890 seed	October 16	25.0	68.0	1.066	10.71	Ripe seed.
8	"Jyangentombi" (not true), 1890 seed	October 16	24.5	52.0	1.075	12.66	Ripe seed.
8	"Jyangentombi" (not true), 1890 seed	October 16	26.3	58.5	1.072	12.36	Ripe seed.
8	Odd from above (not true), 1890 seed	October 26	41.5	63.9	1.063	11.53	Ripe seed.
8	Odd from above (not true), 1890 seed	October 26	40.8	64.5	1.069	11.30	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 14	19.0	73.4	1.065	11.41	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 14	19.8	70.9	1.069	12.27	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 14	17.8	70.4	1.063	10.47	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 14	20.3	70.1	1.071	12.95	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 16	20.0	70.3	1.071	12.56	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 16	18.0	71.1	1.069	12.24	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 16	18.0	72.0	1.071	12.07	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 16	20.3	70.4	1.070	12.42	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 23	20.3	66.0	1.069	11.90	Ripe seed.
9	Boomvana or Early Amber, 1890 seed	October 23	20.3	66.5	1.072	13.30	Ripe seed.

9	Boomvana or Early Amber, 1890 seed....	October 23	19.5	64.1	1.074	13.33	Ripe seed.
9	Boomvana or Early Amber, 1890 seed....	October 23	18.0	63.9	1.071	12.98	Ripe seed.
9	Boomvana or Early Amber, 1890 seed....	October 24	18.5	67.3	1.072	12.63	Ripe seed.
9	Boomvana or Early Amber, 1890 seed....	October 24	18.5	70.3	1.059	10.09	Ripe seed.
9	Boomvana or Early Amber, 1890 seed....	October 24	18.0	70.0	1.065	10.92	Ripe seed.
9	Boomvana or Early Amber, 1890 seed....	October 24	15.5	75.8	1.064	11.04	Ripe seed.
9	Mixed seed from several canes of 1890 Early Amber..........................	October 26	16.5	64.2	1.066	11.13	Ripe seed.
9	Mixed seed from several canes of 1890 Early Amber..........................	October 26	16.0	63.7	1.075	13.12	Ripe seed.
9	Mixed seed from several canes of 1890 Early Amber..........................	October 26	19.3	69.4	1.068	11.53	Ripe seed.
9	Mixed seed from several canes of 1890 Early Amber	October 26	18.5	67.3	1.068	11.80	Ripe seed.
9	Mixed seed from several canes of 1890 Early Amber..........................	October 27	15.8	64.1	1.060	10.15	Ripe seed.
9	Mixed seed from several canes of 1890 Early Amber..........................	October 27	19.5	67.6	1.067	11.90	Ripe seed.
9	Mixed seed from several canes of 1890 Early Amber..........................	October 27	18.0	65.3	1.062	10.21	Ripe seed.
9	Mixed seed from several canes of 1890 Early Amber	October 27	16.3	64.6	1.061	10.12	Ripe seed.
10	Koombana, 1890 seed..................	October 15	16.5	63.6	1.053	6.81	Ripe seed.
10	Koombana, 1890 seed..................	October 15	15.5	64.2	1.049	5.16	Ripe seed.
10	Koombana, 1890 seed..................	October 15	14.5	65.2	1.051	6.41	Ripe seed.
10	Koombana, 1890 seed..................	October 15	15 0	63.3	1.045	4.97	Ripe seed.
10	Koombana, 1890 seed..................	October 22	15.5	60.3	1.062	9.77	Ripe seed.
10	Koombana, 1890 seed..................	October 22	13.3	62.6	1.063	10.15	Ripe seed.
10	Koombana, 1890 seed..................	October 22	14.3	67.5	1.063	9.77	Ripe seed.
10	Koombana, 1890 seed..................	October 22	17.8	65.3	1.050	7.61	Ripe seed.

JUICES OF SORGHUMS, 1891—(*Concluded*).

Row No.	NAME OF VARIETY, ETC.	Date of analysis	Weight of cane. Ounces.	Per cent of juice obtained.	Sp. gr. of juice.	Per cent of sugar by polarization.	Maturity of seed.
10	Koombana, 1890 seed	October 23	13.3	63.2	1.057	8.20	Ripe seed.
10	Koombana, 1890 seed	October 23	13.8	64.5	1.049	6.11	Ripe seed.
10	Koombana, 1890 seed	October 23	11.5	62.8	1.053	6.52	Ripe seed.
10	Koombana, 1890 seed	October 23	11.7	67.9	1.045	5.41	Ripe seed.
11	Pootung sorghum, 1890 seed	October 15	27.5	69.8	1.054	9.28	Ripe seed.
11	Pootung sorghum, 1890 seed	October 15	23.3	68.8	1.049	7.36	Ripe seed.
11	Pootung sorghum, 1890 seed	October 15	23.0	69.6	1.053	7.55	Ripe seed.
11	Pootung sorghum, 1890 seed	October 15	27.0	69.8	1.065	10.24	Ripe seed.
11	Pootung sorghum, 1890 seed	October 22	28.5	69.1	1.048	6.95	Ripe seed.
11	Pootung sorghum, 1890 seed	October 22	27.5	68.6	1.056	7.93	Ripe seed.
11	Pootung sorghum, 1890 seed	October 22	25.8	66.2	1.056	9.28	Ripe seed.
11	Pootung sorghum, 1890 seed	October 22	24.3	66.0	1.054	8.84	Ripe seed.
20	Ubehlana, 1890 seed	October 15	42.0	72.3	1.055	6.18	In bloom.
20	Ubehlana, 1890 seed	October 15	34.8	72.2	1.042	3.29	In bloom.
20	Ubehlana, 1890 seed	October 15	41.8	69.0	1.058	7.36	In bloom.
20	Ubehlana, 1890 seed	October 15	46.5	70.5	1.059	6.78	In bloom.
20	Ubehlana, 1890 seed	October 23	32.5	69.5	1.047	3.35	In bloom.
20	Ubehlana, 1890 seed	October 23	44.3	72.2	1.058	7.30	In bloom.
20	Ubehlana, 1890 seed	October 23	35.0	74.3	1.055	6.00	In bloom.
20	Ubehlana, 1890 seed	October 23	43.3	72.5	1.064	8.78	In bloom.
	Sport from No. 20	October 13	23.3	54.8	1.044	5.21	Ripe seed.
	Sport from No. 20	October 13	26.8	52.2	1.048	6.21	Ripe seed.
	Sport from No. 20	October 13	33.0	58.2	1.060	9.40	In soft dough.
	Sport from No. 20	October 13	37.0	58.1	1.064	10.41	In soft dough.

	Odd cane from 20 sport..................	October 26	27.5	69.1	1.055	8.87	Ripe seed.
	Odd cane from 20 sport..................	October 26	27.5	68.0	1.060	9.85	Ripe seed.
	Odd cane from 20	October 26	28.5	66.7	1.045	5.16	Soft dough.
21	"Early Orange" (D. of A.)........ ...	October 26	31.5	69.5	1.055	8.09	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 15	22.0	66.0	1.058	9.17	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 15	21.0	66.4	1.051	7.64	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 15	21.3	68.8	1.061	9.17	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 15	16.0	67.2	1.060	9.37	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 23	21 3	68.7	1.066	10.30	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 23	21.3	70.4	1.058	8.90	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 23	24.0	68.1	1.060	9.40	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 23	21.0	67.1	1.061	9.85	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 24	20.5	68.3	1.067	12.10	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 24	23.0	68.3	1.060	9.91	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 24	19.5	75.6	1.061	9.70	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 24	18.5	68.8	1.057	9.31	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 26	21.8	69.4	1.046	5.79	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 26	20.0	66.0	1.059	8 81	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 26	19.0	67.1	1.060	9.53	Ripe seed.
72	Early variety, from S. H. Kenny, 1890 seed	October 26	18.3	66.8	1.060	9.04	Ripe seed.

REPORT OF THE CHEMIST.*

The present annual report covers the period extending from December 1, 1890, to December 1, 1891. The following statement indicates, in outline, the various subjects considered:

I. Summary of laboratory work.
II. Arrangement of chemical work.
III. Bulletins and addresses.
IV. Experiments in the manufacture of cheese.
V. Loss of milk constituents in cheese-making.
VI. Influence of composition of milk on composition of cheese.
VII. Influence of composition of milk on yield of cheese.
VIII. Comparison of Cheddar and stirred-curd processes of manufacture.
IX. Comparison of commercial and home-made rennet-extract.
X. Changes taking place in the ripening of cheese.
XI. Lines of work in future investigations of cheese.
XII. Results of investigation of cheese applied to practical dairy problems.
XIII. General summary of results of investigation of cheese.
XIV. Comparison of dairy breeds of cattle with reference to production of butter.
XV. Comparison of dairy breeds of cattle with reference to production of cheese.
XVI. The influence of advancing lactation upon the production of butter.
XVII. The influence of advancing lactation upon the production of cheese.
XVIII. How to ascertain the butter-making efficiency of milk-fat.
XIX. Comparison of methods of creaming milk by setting and by centrifugal machine.
XX. Analyses of materials used in spraying plants.

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* I. L. Van Slyke, Ph. D.

XXI. Analyses of sprayed grapes.
XXII. Explanation of terms of chemical analysis in relation to fertilizers.
XXIII. Method of making commercial valuations of fertilizers.
XXIV. Tabulated statement of fertilizing composition and valuation of various products.
XXV. Tabulated results of analyses of commercial fertilizers in New York State for the fall of 1890.
XXVI. Tabulated results of analyses of commercial fertilizers in New York State for the spring of 1891.

I. SUMMARY OF LABORATORY WORK.

While a statement of the number of determinations of different kinds does not include an account of all kinds of laboratory work and does not, therefore, necessarily convey an accurate idea in regard to the whole amount of laboratory work done, nevertheless, it serves to give fairly adequate information in regard to the extent, character and variety of the chemical and allied work. It will be noticed that our chemical work has been mainly confined to two lines, investigations connected with dairy problems and analysis of fertilizers. When we have become satisfactorily settled in the new chemical laboratory we shall be able to accomplish a large amount of work without increased effort.

TABULATED STATEMENT OF LABORATORY WORK FOR THE YEAR.

	In milk.	In skim-milk.	In buttermilk.	In butter.	In cheese.	In whey.	In cheese curd.	In cattle foods.	In fertilizers.	In fungicides.	In maple sugar.	Totals.
Determinations of nitrogen	1,492	....	....	....	148	44	16	228	496	....	....	2,424
Determinations of fat (Babcock test)....	1,584	1,926	758	....	12	8	12	....	....	....	....	4,300
Determinations of fat (ether-extract)....	92	....	....	758	94	44	12	114	....	....	....	1,114
Determinations of water....	1,492	....	....	758	84	44	14	114	....	....	22	2,528
Determinations of ash....	746	....	....	....	72	44	14	114	....	....	....	990
Determinations of crude fiber....	....	....	....	....	....	....	....	114	....	....	....	114
Determinations of sucrose	....	....	....	....	....	....	....	114	....	....	22	136
Determinations of invert sugar....	....	....	....	....	....	....	....	114	....	....	....	114
Determinations of starch	....	....	....	....	....	....	....	114	....	....	....	114
Phosphoric acid	....	....	....	....	....	....	....	....	1,488	....	....	1,488
Potash....	....	....	....	....	....	....	....	....	496	....	....	496
Lactic acid....	....	....	....	....	74	40	....	....	....	....	....	114
Copper	....	....	....	....	....	....	....	....	....	44	....	44
Microscopical examinations	388	....	....	....	....	....	....	....	....	....	....	388
Miscellaneous determinations	....	....	....	....	....	....	....	....	....	....	....	160
Grand total	....	....	....	....	....	....	....	....	....	....	....	14,524

II. ARRANGEMENT OF CHEMICAL WORK.

The chemist gives such general and special supervision to all the different lines of work as they may require. The chemical work connected with the investigation of cheese, with the analysis of fungicides, and with a portion of the miscellaneous work, has been mainly done by the chemist personally. The work done in the way of preparing bulletins and giving addresses is given below under a special head.

The present arrangement of chemical work among the assistant chemists is as follows:

Mr. C. G. Jenter has special charge of the analysis of butter, of most of the cattle foods and similar substances and of certain special and miscellaneous analytical work.

Mr. A. L. Knisely has special charge of the analysis of milk, of microscopical examinations of milk, and also assists in the analysis of cattle foods, etc.

Mr. S. Ando assists in the analysis of milk, skim-milk, etc., in the determinations of nitrogen and in general laboratory work.

Mr. W. H. Andrews and Mr. B. L. Murray give their entire time, to the analysis of commercial fertilizers and fertilizing materials.

In connection with the investigation of comparing dairy breeds of cattle, Mr. A. H. Horton has charge of the numerous calculations and records connected with the butter work and milk work; and Mr. R. D. Newton, among other duties, has charge of the calculations and records connected with the food eaten, milk yield and the general stable record. The details of the practical dairy work are in charge of Mr. I. Phillips.

III. BULLETINS AND ADDRESSES.

During the year the chemist has prepared the following station bulletins:

Bulletin No. 26—New Series—January, 1891. (25 pages.) Outline of the history of commercial fertilizers. General principles underlying the use of fertilizers. Results of analyses of commercial fertilizers.

Bulletin No. 27—New Series—February, 1891. (20 pages.) General principles underlying the use of fertilizers. Results of analyses of commercial fertilizers.

Bulletin No. 32 — New Series — June, 1891. (30 pages.) Description of materials used in making commercial fertilizers. Fertilizing materials produced on farms. Fertilizing composition and valuation of various products. Results of analyses of commercial fertilizers.

Bulletin No. 33 — New Series — July, 1891. (20 pages.) Explanation of terms of chemical analysis. Commercial valuations of fertilizers. Composition of various chemical compounds. Results of analyses of commercial fertilizers.

Bulletin No. 34 — New Series — August, 1891. (46 pages.) Comparison of dairy breeds of cattle with reference to production of butter.

Bulletin No. 37 — New Series — November, 1891. (70 pages.) Investigation of cheese. Experiments in the manufacture of cheese. Influence of composition of milk on composition and yield of cheese. A study of the process of ripening of cheese.

During the year the chemist has given the following addresses:

"Chemistry of Dairy Products," in December, 1890, at Walton, N. Y., before the annual convention of the New York State Dairymen's Association.

"Fruits from a Chemist's Standpoint," in January, 1891, at Rochester, before the annual convention of the Western New New York Horticultural Society.

"Commercial Fertilizers," in February, March and April, at farmers' institutes, held in the following places: Geneva, Ontario county; Norwich, Chenango county; Cortland, Cortland county; Owego, Tioga county; Horseheads, Chemung county; Fayetteville, Onondaga county.

In August and September, 1891, a course of lectures before the dairy school held at Geneva by the New York State Dairymen's Association on the following subjects: "The Chemistry of Milk, Cream, Skim-milk, Buttermilk and Butter;" "The Physical Properties of Milk;" "Bacteria in Relation to Milk, Cream and Butter;" "Some Dairy Whys, or Science Applied to Dairy Methods;" "Methods of Testing Milk for Fat."

EXPERIMENTS IN THE MANUFACTURE OF CHEESE.

OBJECTS OF INVESTIGATION.

For some time past it has been the purpose of the Station to enter upon a series of investigations relating to the manufacture of cheese. At the suggestion of the director, the Station chemist began the first of this proposed series of investigations in September, 1891. Six lots of cheese were made in September and, two more in October.

The general object of these experiments is to make a study of the various conditions that affect the composition and quality of cheese.

The special objects of this first investigation were to ascertain —

First. How much fat can be readily worked into cheese;

Second. What influence varying amounts of fat in milk have upon the amount of fat and of nitrogen compounds that can be recovered in cheese;

Third. Whether there is any better recovery of fat or of nitrogen compounds in the stirred-curd process of manufacture than in the Cheddar process;

Fourth. Whether there is any difference in the use of commercial rennet-extract and of home-made rennet-extract;

Fifth. What general changes in composition take place in the ripening or curing of cheese.

While, in most respects, fairly definite results were obtained, it must be kept in mind that the experiments, so far, are few in number and can scarcely justify any broad conclusions. The results of this first series of experiments should be looked upon mainly as valuable suggestions for future work; and if the results of several series of investigations, made under varying conditions, agree, then we may be able to state definite general conclusions, which may be regarded as established facts.

In this connection, it should be stated that the Station is indebted to the kindly co-operation of the New York State Dairy Commissioner, Mr. J. K. Brown, who detailed the well-known experts in cheese-making, Mr. G. A. Smith and Mr. W. W. Hall, to manufacture the cheese for the experiments. Mr. Hall worked with Mr. Smith in the four experiments dating from September seventeenth to September twenty-first, inclusive. In the other experiments the cheese-making was done by Mr. Smith alone. Thus, the first requirement necessary to the success of the experiment, skill in making the cheese, was secured.

COMPOSITION OF MILK AND CHEESE.

In order that the analyses of milk, whey and cheese, contained in this report, may be intelligible to cheese-makers and to others who do not chance to be acquainted with the composition of milk, cheese, etc., it is desirable to present some of the main facts in this connection.

The following outline gives the names of the constituents found in milk and its derived products, as they are usually reported in analysis:

- I. Water.
- II. Total solids.
  - 1. Fat.
  - 2. Solids not fat.
    - (1.) Nitrogen compounds (casein, albumen, etc.).
    - (2.) Sugar.
    - (3.) Ash.

1. *Water and total solids.*— The compounds contained in milk, cheese, etc., can be divided into two general classes. The first class includes the single compound, *water.* The second class includes the *total solids*, by which we mean all the compounds except water. The amount of total solids is found by evaporating the water, the portion left after evaporation being the total solids. The amount of water and total solids in milk varies considerably according to the breed of cow, period of lactation, food, etc. The amount of water in milk may vary from eighty to ninety pounds per hundred, the average in normal milk being about eighty-seven pounds per hundred. The amount of total solids may vary from ten to twenty pounds per hundred. The average being not far from thirteen pounds per hundred.

The total solids are usually divided into two classes, (1st) *fat*, and (2d) *solids not fat.*

2. *The fat* of milk, butter, cheese, etc., consists of a mixture of several compounds, each of which contains glycerine united with some acid. The more important of these compounds, contained in the fat of milk, cheese, butter, etc., are the following:

(1) *Olein* (glycerine united with oleic acid),
(2) *Palmitin* (glycerine united with palmitic acid),
(3) *Stearin* (glycerine united with stearic acid),
(4) *Butyrin* (glycerine united with butyric acid).

A large proportion of olein or of butyrin in a fat makes a soft or easily melting fat, while a large proportion of palmitin or stearin makes a hard fat. The amount of fat in milk may vary from two to ten pounds per hundred of milk, the average amount being not far from 3.5 pounds per hundred. Butter contains from eighty to eighty-five pounds of fat per hundred, while cheese may contain all the way from three pounds of fat per hundred pounds of cheese, as in skim-cheese, to sixty pounds per hundred, as in cream-cheese. The average amount of fat in cheese made from normal milk averages thirty pounds or more per hundred.

3. *The solids not fat* in milk, cheese, etc., include all the solids except the fat, and these are (1st) the *nitrogen compounds*, chief of which are *casein* and *albumen;* (2d) *milk sugar*, and (3d) *ash.*

(1) *Casein* and *albumen* are known as nitrogen and nitrogenous compounds, because they contain, in addition to other elements the element nitrogen, which the other compounds of milk do not contain. These nitrogen compounds are often called also albuminoids, because they closely resemble in composition the albumen or white of an egg. They are sometimes called proteids also,

The two principal nitrogen compounds or albuminoids in milk are *casein* and *albumen* and these compounds are the only ones we shall notice in this connection. Casein and albumen are of more especial interest to the cheese-maker than any other constituents in the milk. Of these two compounds, the casein is the more important. Casein and albumen differ in their chemical properties in two important respects:

(1st) Albumen is not coagulated or solidified by acids or by action or rennet, while casein is coagulated.

(2d) Albumen is coagulated by heat, while casein is not. These properties of casein and albumen have a practical bearing upon cheese-making, since by the action of rennet we can coagulate the casein and retain it in the curd, while the albumen passes into the whey more or less completely and is lost to the cheese. The amount of casein and albumen together in normal milk may vary from below three to over four pounds per hundred, the average amount being a little short of 3.5 pounds per hundred.

(2) *Milk Sugar* has essentially the same composition as ordinary cane sugar, but the former is less soluble and less sweet than the latter. Milk sugar is acted upon by certain micro-organisms

or minute germs, or, as we commonly say, it ferments, forming, as one of its chief products, lactic acid, the characteristic acid of sour milk. The sugar, in the process of cheese-making, passes mostly into the whey. In some few places, the milk sugar is obtained from the whey and converted into an article of commerce, for which there is a limited demand, but, in most cases, no attempt is made to recover it. The amount of sugar in milk averages not far from five pounds per hundred.

(3) The *Ash* in milk consists of what is left after milk is burned as completely as possible. It contains compounds made up of such elements as calcium, phosphorus, potassium, sodium, magnesium, oxygen, sulphur, chlorine, iron, etc. A large part of the ash-constituents is lost in the whey. The average amount of ash in milk is about three-fourths of one pound per hundred pounds of milk. The calcium (or lime) compounds in milk are of especial importance in connection with the process of cheese-making, since it has been recently shown that rennet will not coagulate the casein of milk unless some *soluble calcium compound* is present, though it is not clearly understood in exactly what way the calcium compounds influence the action of rennet.

The following table will give a fair idea of the average composition of normal milk :

	Pounds per hundred.
Water	87.2
Total solids	12.8
Fat	3.8
Solids not fat	9.0
Casein and albumen	3.3
Sugar	5.0
Ash	0.7

ACTION OF RENNET UPON THE CASEIN OF MILK.

The action of rennet in coagulating the casein of milk is due to a chemical ferment contained in the rennet. This ferment, when introduced into milk, acts at certain temperatures with great rapidity, and produces marked changes, chief among which is the coagulation or solidification of the casein. The exact chemical changes produced in casein by its coagulation are not satisfactorily understood. The formation of lactic acid in cheese-making is doubtless produced by the lactic acid bacteria and not by the rennet-ferment.

PROCESS OF MANUFACTURING CHEESE.

General outline. The process of manufacturing cheese is, in brief outline, as follows: The casein of the milk is coagulated by the action of rennet. The coagulated casein or curd, which is at first soft and full of moisture, is cut into small pieces and allowed to stand at a certain temperature until the curd becomes tough and less moist. The whey is then removed, and the curd, after draining sufficiently, is mixed with salt, then put into molds and subjected to a gradual pressure. After being in press several hours the cheese is placed in a room of even, moderate temperature, when it undergoes certain changes, acquiring, in time, the flavor and other well-known properties of cheese.

The general principle underlying the manufacture of cheese depends, primarily, upon the action of rennet on milk. While the theory of cheese-making depends upon this easily stated principle, and while the actual process might, from the foregoing outline, appear extremely simple, the manufacture of cheese is, in reality, a complicated process in its details, and requires, for highest success, rare skill and trained judgment. In order to present some of the difficulties encountered in cheese-making, we will consider the process more in detail.

SOME DETAILS OF CHEESE-MAKING.

(1.) *Treatment of milk before adding the rennet.*—In making cheese, the milk is gradually heated to a temperature of about 85° F., a slightly higher or lower temperature being used according to the judgment of the maker, as peculiar conditions may demand. The heating of the milk is accompanied by careful stirring, in order to enable the milk to heat uniformly and also to keep the fat evenly distributed through the milk. The milk is held at about 85° F. until a very slight amount of acid has been developed, usually known as "*ripening;*" this ripening may be hastened by the addition of a small quantity of sour milk. In the experiments described in this report, John Boyd's "starter" was used. The exact degree of ripeness is difficult to determine, but the skilled cheese-maker appears to acquire a sort of intuition, as a result of long training in close observation, which enables him to tell the proper point. The object of ripening the milk before adding the rennet is probably to render the action of the rennet more rapid. Doubtless, ripening has some other influence, the bacteria thus added in the form of a "starter" tending to develop more quickly in the cheese a higher flavor, as in the case of ripening cream for making butter. In reality, we do not yet understand at all satisfactorily exactly what influence the ripening of milk has upon the process of cheese-making or upon the finished product.

(2) *Addition of rennet.*— When the milk has been held at about 85° F. until properly ripened, a solution prepared from rennet is added in certain proportions according to the quantity of milk used. The action of the rennet is, as previously stated, to solidify or coagulate the casein of the milk. In solidifying, the casein of the milk entangles and holds fast, mechanically, a large proportion of the fat of the milk, and, also, more or less of the ash and sugar of the milk. The rennet may cause the milk, if properly ripened, to coagulate in ten to twenty minutes; while, if added to milk that has not been ripened, the rennet may not cause proper thickening of the milk short of two hours.

(3.) *Cutting the curd.*— Again the trained judgment of the cheese-maker must be called into action in order to determine when the curd is firm enough to cut and yet not too firm. In the experiments described in this report, the milk thickened enough for cutting in about fifteen or twenty minutes after the rennet was added. For cutting curd, knives containing several blades, about half an inch apart, are used. The curd, when cut, is left in small cubes, each not more than half an inch in diameter.

The main loss of fat probably takes place in the process of cutting and of handling immediately following. The fat globules on the exposed surfaces of each small piece of curd are easily detached, and hence in cutting and in subsequent handling any undue mangling or violence increases the amount of fat lost.

(4.) *Stirring and heating the curd.*— As soon as the curd is completely cut, it is stirred very gently for ten or fifteen minutes, until the outside of the pieces of curd show the appearance of a slight film and the whey commences to separate freely from the curd. The curd is then heated gradually to a temperature of about 98° F. The rapidity of heating and the extent of heating are points which the judgment of the maker must determine. During the heating, the curd is kept in constant but gentle agitation. This heating causes each piece of curd to shrink and expel moisture, whereby it becomes more firm and dry. In regard to the details of this shrinking and drying action, much remains to be learned, but it is probably due to the combined action of heat, of rennet, and of lactic acid. After the temperature has reached about 98° F., the heating is discontinued and the curd is stirred only at intervals sufficient to prevent its packing on the bottom of the vat. When the curd has become sufficiently firm and dry, it is allowed to settle and the whey is drawn off. To tell exactly when is the proper time to draw the whey from the curd requires the very best judgment of the maker, for this is one of the most critical points in the manufacturing process. Here, cultivated sense of smell, touch, taste and sight is needed. The most common test used to determine the proper time to draw off the whey is known as the iron-test. A portion of curd is squeezed in the hand, then placed against a hot iron, and carefully drawn away from the iron. If the curd sticks to the iron and is drawn out in little threads, about one-fourth of an inch long, the whey is generally ready to be drawn; if the threads are shorter, the action is continued until a satisfactory test is obtained. This test is supposed by the cheese-maker to indicate the amount of lactic acid present. That it is a rough test for the relative amount of acid present, our experiments showed conclusively. The curd acquires the property of being drawn out into threads, probably by action of rennet rather than of acid. It is stated that in milk coagulated by acid alone the curd does not acquire the property of being drawn into threads.

After the whey is drawn from the curd, the process of manufacture may be varied, one method of treatment making what is known as a *stirred-curd* cheese, and the other method a *Cheddar* cheese. We will briefly describe each of these procosses.

(5.) *Stirred-curd cheese.*— After the whey has been drained from the curd, the curd is stirred and kept broken up so as to prevent packing. It is kept at a certain temperature, until certain signs indicate to the maker that the curd is ready for the press. The curd is then mixed with salt and put into a mold or hoop and subjected to pressure for at least twelve hours before being removed from the hoop.

(6.) *Cheddar cheese.*—After the whey has been drained from the curd, the curd is packed on opposite sides of the vat, leaving a space in the center to enable the whey to drain off more readily. After a time the curd becomes packed or matted and is cut into pieces of such size as may be convenient to handle. These pieces are turned over from time to time to allow the whey to drain more quickly. When the curd has become pretty well freed from whey, the pieces are doubled, and the process of doubling is continued at short intervals until the whole forms a compact pile. It is then held at a certain temperature until it assumes a certain condition, which the eye and touch of the maker can detect. The curd is then torn up, spread out and cooled to about 85° F. It is then run through a curd mill, which is a knife made so as to cut the curd into square strips, half an inch in diameter. After being cut completely, the curd is salted and put to press.

CHEESE-MAKING AND SCIENCE.

From the preceding description of some of the difficulties of cheese-making, it will be readily seen that there is abundant opportunity for purely scientific study. We do not understand the reasons for many of the steps in the process. Exactly what influences ripening of milk has upon the action of rennet, and upon the manufactured product, we can not say definitely; much less can we say how the results, whatever they may be, are accomplished. We are not entirely certain that we know the exact composition of the casein of milk, and we are quite certain that we do not know satisfactorily what particular changes the action of rennet produces in the composition of casein. We do not know what changes the casein undergoes as the process continues and the curd becomes harder. The cheese-maker depends upon certain signs or indications to tell him when to cut the curd, when to draw the whey from the curd and when to put the curd to press. The reasons underlying his method he can not give. The average cheese-maker goes through a certain series of operations, and gets results such as he can. He does not vary his method in any respect for fear he may not get good results. Before cheese-making becomes a process that can be controlled in all its steps so as to make a uniform product, or a product that varies at the will of the maker, much purely scientific work must be done.

PLAN OF INVESTIGATION.

The milk.— The milk used in the different experiments was mixed milk of various breeds of cows. In some cases it consisted of milk from two or three days' milkings, while in most cases it consisted mainly of fresh morning milk, mixed with milk of the previous evening. The details regarding the character of the milk used are stated later in the description of the individual experiments. The amount of fat in the milk was regulated by skimming or adding cream, according to the conditions desired; the amount of fat was determined by the Babcock test, and if the per cent of fat was not found to be approximately the one desired, then cream or skim-milk was added and the mixture tested again, until the desired result was obtained. Only two tests were usually required, and in some cases the approximate amount was hit upon at the first trial. Special care was taken in sampling the milk for analysis; and, as the amount of milk used was not large, no difficulty was experienced in getting thoroughly representative samples.

Description of whey.— The whey was sampled at three different stages of the work, being called in the analytical tables *first whey*, *second whey* and *third whey*. The *first whey* included the great bulk of whey, which was first drawn from the curd. The *second whey* included the portion that drained from the curd, as soon as the whey running from the curd was no longer clear but became turbid and white in appearance. The amount was not large in any case, and in one or two cases, where the amount of fat in the milk was small, only clear whey drained from the curd. The *third whey* included the portion that drained from the curd after salt was added and also the drainings from the press. Any fat that came from the cheese by pressure was carefully rinsed by hot water into the *third whey*. The amount of whey was small in most cases and an accurate determination of the fat was difficult, as the fat accumulated on the surface of the whey in a separate layer. In the sixth experiment, the third whey was lost by accident before being sampled.

Analysis of curd.— In several of the experiments, the curd was analyzed, but as it proved difficult to get representative samples, the analysis was abandoned. The chief difference in composition between the curd and green cheese is mainly in moisture and salt, and, in a much lesser degree, in fat and nitrogen compounds.

Analysis of cheese.— In six experiments, the first analysis of the cheese was made when the cheese was seven days old; in two experiments, the green cheese, as it came from the press, was sampled for analysis. In all experiments, each cheese was analyzed at the age of seven, twenty-one and thirty-five days, in order to ascertain the general changes taking place before cheese goes to market.

DIFFICULTIES CONNECTED WITH THE INVESTIGATION.

The principal source of difficulty in carrying on the work has been the sampling of cheese for analysis. It is highly desirable to get for analysis such a sample as will fairly represent the composition of the whole cheese. If a cheese could be cut up and portions selected here and there, the difficulty would be largely removed. But where it is necessary to preserve the cheese to continue the study of its composition through a period of several months, such a course is not feasible. The only practicable method and the one employed has been to use a regular cheese-trier, which takes out a cylinder of cheese about six inches long and five-eights of an inch in diameter. The samples were taken from the cheese at points about half way between the center and circumference of the flat surface or face of the cheese. The cylinders thus taken are cut up into very thin pieces and the whole mixed carefully, pains being taken to prevent loss of moisture in the operation. From samples thus prepared, portions are weighed out for analysis. By comparing the pounds of constituents in the cheese as given by analysis of different samples of the same cheese, it will be noticed that in several instances the results are not consistent. For example, in the sixth experiment, the amount of casein in the cheese as obtained by analysis of different samples, taken at different times, is as follows: In green cheese, 9.1 pounds; in cheese seven days old, 8.68 pounds; in cheese twenty-one days old, 9.26 pounds; in cheese thirty-five days old, 8.5 pounds. It is improbable, not to say impossible, that the amount of casein should vary so irregularly merely as a result of the ripening process. We can readily account for it only on the ground that there was a real difference in the samples analyzed. Irregular variation of other constituents is also noticeable. This is, perhaps, not surprising when we consider that a cheese is often more porous in some places than in others, that some of these pores are often filled with water or with pure fat, that the amount of moisture varies in different portions.

The determination of total solids gave considerable difficulty, while those of fat and nitrogen were, on the whole, fairly satisfactory. It will be noticed that the ash varies in a remarkable manner. Special pains were taken in experimenting with a large number of ash determinations but uniform results were difficult to obtain from different samples. The amount of ash constituents in a cheese should not vary, as they can not escape from the cheese in the process of ripening, and the pounds of ash should remain the same from week to week. From the decided variations found in different samples, we are led to believe that the salt is not distributed through the cheese with sufficient uniformity to enable one to make an accurate analysis for the whole cheese from one sample.

One series of experiments was made in which analyses of samples taken from the flat surface of the cheese were compared with those taken from the middle of the side. In some instances the agreement was fair, while in others the variation was marked. It is planned to make a more thorough examination of samples taken from different parts of cheese in order to see to what extent and in what manner different portions vary.

In addition to the difficulty of securing samples that represent the composition of the whole cheese, the methods of cheese analysis are imperfect in some respects.

NOTES ON ANALYTICAL METHODS.

Determinations of fat in cheese made by the Babcock method were compared with those made by the gravimetric method. Satisfactory duplicates were not obtained by the Babcock method nor did the results agree closely with the laboratory method and its use was abandoned as not being sufficiently accurate for this special work. All the determinations of fat were made by the gravimetric method.

The determinations of acid in whey were made immediately after the samples were taken and were calculated as lactic acid.

In the tables containing analytical data, the actual number of pounds of ash and sugar is omitted, since the data are of no special value in this investigation. If any one is interested to learn the amounts, the data necessary for their calculation are in the tables.

In the detailed description of the individual experiments following, the experiments are arranged, not in chronological order, but according to the amount of fat in the milk used in each experiment, commencing with the lowest. This arrangement will make reference to the tables more convenient than an arrangement in chronological order.

FIRST EXPERIMENT.

1. *Date.*— September 19, 1891.
2. *Kind of cheese.*— Stirred-curd.
3. *Description of milk used.*— Morning milk, fresh, 61.56 pounds; evening milk, twelve hours old, 234.38 pounds; from which were taken 55.54 pounds of cream, leaving, for use in the experiment, of mixed whole milk and skim-milk, 240.4 pounds.
4. *Details of process of manufacture.*— Temperature of milk at beginning, 60° F.; commenced to heat at 9.50 A. M.; temperature of 86° F. reached at 10.25; Hansen's rennet extract added at 10.38; milk began to thicken at 10.46; curd cut at 11, and then stirred; commenced to heat again at 11.05; temperature of 93° reached at 11.30; whey drawn from curd at 1.06 P. M.; curd drained until 2.05 and then salted with 0.48 pounds of salt; curd put to press at 3.10. Amount of green cheese, 23.5 lbs.

ANALYSES CONNECTED WITH THE FIRST EXPERIMENT.

	COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							COMPOSITION EXPRESSED IN POUNDS.					
	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of ash.	Per cent. of lactic acid.	Per cent. of sugar.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of lactic acid.
Milk	88.33	11.67	2.35	3.34	0.83	......	5.15	240.40	212.34	28.06	5.65	8.03	......
First whey Second whey	94.16	5.84	1.70	0.79	0.82	0.18	3.88	206.30	194.25	12.05	0.35	1.63	0.37
Third whey	89.96	10.04	0.26	1.08	3.39	......	5.31	6.63	5.96	0.67	0.02	0.07	......
Cheese, green	......	......	......	......	......	......	......	23.50	......	......	......	......	......
Cheese, seven days	42.64	57.36	24.28	27.59	3.42	1.17	......	22.90	9.76	13.14	5.56	6.31	0.27
Cheese, twenty-one days	42.22	57.78	23.47	26.60	2.83	1.06	......	22.28	9.40	12.88	5.23	5.92	0.24
Cheese, thirty-five days	41.15	58.85	23.27	28.72	3.52	0.76	......	21.75	8.95	12.80	5.06	6.25	0.17

SECOND EXPERIMENT.

1. *Date.*— September 22, 1891.

2. *Kind of cheese.*— Stirred-curd.

3. *Description of milk used.*— Morning milk, twenty-four hours old, 46.44 pounds; evening milk, twelve hours old, 246.56 pounds; "starter" added, seven pounds. Total amount of milk used in this experiment, 300 pounds.

4. *Details of process of manufacture.*— Temperature of milk at beginning, 65° F.; commenced to heat at 9.14 A. M.; temperature of 84° F. reached at 9.55; three-fourths of an ounce of Hansen's rennet-extract added at 10; milk began to thicken at 10.11; commenced to cut curd at 10.20; commenced to stir at 10.25; commenced to heat again at 10.40; temperature of 96° F. reached at 11.25; whey drawn from curd at 12.20 P. M.; curd drained until 2; 0.75 pounds of salt added; curd put to press at 3.35. Amount of green cheese, 29 pounds.

ANALYSES CONNECTED WITH THE SECOND EXPERIMENT.

	COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							COMPOSITION EXPRESSED IN POUNDS.					
	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of ash.	Per cent. of lactic acid.	Per cent. of sugar.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of lactic acid.
Milk	88.44	11.56	3.01	2.81	0.99	......	4.75	300.00	265.32	34.68	9.03	8.43	......
First whey	92.65	7.35	0.21	0.54	1.01	0.17	5.42	251.00	232.55	18.45	0.53	1.35	0.43
Second whey	92.41	7.59	0.22	0.81	1.07	0.26	5.23	12.10	11.18	0.92	0.03	0.10	0.03
Third whey	89.45	10.55	0.53	1.20	6.58	......	2.24	4.68	4.18	0.50	0.02	0.06	......
Cheese, green	......	......	......	......	......	......	......	29.00	......	......	......	......	......
Cheese, seven days	37.71	62.29	29.61	23.24	3.67	0.69	......	28.00	10.56	17.44	8.29	6.51	0.19
Cheese, twenty-one days	36.98	63.02	29.97	24.38	3.79	0.79	......	27.25	10.08	17.17	8.17	6.64	0.21
Cheese, thirty-five days	36.35	63.65	30.62	27.49	4.20	0.65	......	26.56	9.66	16.90	8.13	7.30	0.17

THIRD EXPERIMENT.

1. *Date.*— September 18, 1891.

2. *Kind of cheese.*— Stirred-curd.

3. *Description of milk used.*— Evening milk, 12 hours old, 236.69 pounds, from which 14.5 pounds of cream were taken, leaving 222.19 pounds for experiment; fresh morning milk, 58.71 pounds; "starter," four pounds. Total amount of milk and skim-milk used in this experiment, 284.9 pounds.

4. *Details of process of manufacture.*— Temperature of milk at beginning, 77° F. commenced to heat at 9.34 A. M.; temperature of 85° F. reached at 9.50; "starter" added at 9.48, and seven-eighths of an ounce of rennet-extract at 9.50; milk began to thicken at 10; commenced to cut curd at 10.04, and to stir at 10.08; commenced to heat again at 10.24; temperature of 97° F. reached at 11.40; whey drawn from curd at 12.25 P. M.; curd drained until 1.45; 0.75 pounds of salt added; curd put to press at 3.50. Amount of green cheese, 31.13 pounds.

ANALYSES CONNECTED WITH THE THIRD EXPERIMENT.

	COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							COMPOSITION EXPRESSED IN POUNDS.					
	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of ash.	Per cent. of lactic acid.	Per cent. of sugar.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of lactic acid.
Milk	87.47	12.53	3.88	3.45	0.91	......	4.29	284.90	249.20	35.70	11.05	9.83	......
First whey	93.30	6.70	0.31	1.04	0.58	0.16	4.61	233.20	217.57	15.63	0.72	2.43	0.37
Second whey	93.14	6.86	0.43	1.28	0.74	0.26	4.15	12.40	11.55	0.85	0.05	0.17	0.03
Third whey	85.99	14.01	0.60	1.36	5.96	......	6.09	4.10	3.53	0.57	0.02	0.06	......
Cheese, green	......	......	......	......	......	......	......	31.13	......	......	......	......	......
Cheese, seven days	35.09	64.91	34.60	24.37	3.09	1.27	......	30.03	10.54	19.49	10.39	7.32	0.38
Cheese, twenty-one days	34.88	65.12	33.91	24.77	3.26	0.92	......	29.40	10.26	19.14	9.97	7.28	0.27
Cheese, thirty-five days	34.53	65.47	34.96	25.65	3.88	0.72	......	28.80	9.94	18.86	10.06	7.38	0.21

FOURTH EXPERIMENT.

1. *Date.*— October 9, 1891.

2. *Kind of cheese.*— Cheddar.

3. *Description of milk used.*— Evening milk, thirty-six hours old, 64.31 pounds, from which 12.75 pounds of cream were taken, leaving 51.56 pounds of skim-milk for use in experiment; evening milk, twelve hours old, 34.99 pounds, from which 5.78 pounds of cream were taken, leaving 29.21 pounds of skim-milk for experiment; evening milk, twelve hours old, 123.5 pounds; fresh morning milk, 71.38 pounds; cream, fifteen pounds; "starter," 6.65 pounds. Total amount of whole milk, skim-milk and cream used in this experiment, 297 3 pounds.

4. *Details of process of manufacture.*— Temperature of milk at beginning 61° F.; commenced to heat at 8.45 A. M.; temperature of 85° F reached at 9.20; three-fourths of an ounce of rennet-extract added at 9.44; milk began to thicken at 9.52; commenced to cut curd at 10.02, and to stir at 10.07; commenced to heat again at 10.25; temperature of 98° F. reached at 11.18; whey drawn from curd at 12.40 P. M.; curd drained until 3.35, then salted and ground; 0.75 pounds of salt added; curd put to press at 3.50. Amount of green cheese 36.31 pounds.

ANALYSES CONNECTED WITH THE FOURTH EXPERIMENT.

	COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							COMPOSITION EXPRESSED IN POUNDS.					
	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of ash.	Per cent. of lactic acid.	Per cent. of sugar.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of lactic acid.
Milk	87.57	12.43	3.96	3.81	0.88	......	3.78	297.3	260.35	36.95	11.77	11.33	......
First whey	93.76	6.24	0.31	1.07	0.61	0.17	4.08	240.19	225.20	14.99	0.74	2.57	0.41
Second whey	93.22	6.78	0.44	0.85	0.71	0.24	4.54	14.31	13.44	0.97	0.06	0.12	0.03
Third whey	90.93	0.07	0.95	1.24	4.88	0.65	1.35	4.25	3.86	0.39	0.04	0.05	0.03
Cheese, green	38.26	61.74	29.91	22.72	3.72	0.58	......	36.31	13.89	22.42	10.86	8.25	0.21
Cheese, seven days	37.33	62.67	31.19	23.12	3.44	0.46	......	35.28	13.17	22.11	11 00	8.16	0.16
Cheese, twenty-one days	38.01	61.99	29.51	24.38	3.78	0.42	......	34.16	12.98	21.18	10.08	8.33	0.14
Cheese, thirty-five days	37.49	62.51	30.87	23.69	2.65	0.53	......	33.44	12.54	20.90	10.32	7.92	0.17

FIFTH EXPERIMENT.

1. *Date.*—September 17, 1891.

2. *Kind of cheese.*—Stirred-curd.

3. *Description of milk used.*—Morning milk, 48 hours old, 32.56 pounds; evening milk, 36 hours old, 45.06 pounds; morning milk, 24 hours old, 72.56 pounds; evening milk, 12 hours old, 108.44 pounds; fresh morning milk, 63.19 pounds; "starter," 4 pounds. Total amount of milk used in this experiment, 325.8 pounds.

4. *Details of process of manufacture.*—Temperature of milk at beginning, 63° F.; commenced to heat at 9.20 A. M.; temperature of 84° F. reached at 9.45; "starter" added at 9.45 and then one ounce of rennet-extract; milk began to thicken at 9.59; commenced to cut curd at 10.08; and to stir at 10.14; commenced to heat again at 10.31; temperature of 98° F. reached at 11.29; whey drawn from curd at 1.20 P. M.; curd drained until 2.20; 0.81 pounds of salt added; curd put to press at 4. Amount of green cheese, 38.6 pounds.

ANALYSES CONNECTED WITH THE FIFTH EXPERIMENT.

	COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							COMPOSITION EXPRESSED IN POUNDS.					
	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of ash.	Per cent. of lactic acid.	Per cent. of sugar.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of lactic acid.
Milk	86.42	13.58	4.70	3.91	0.65	......	4.32	325.8	281.56	44.24	15.31	12.73	......
First whey	93.10	6.90	0.41	1.25	0.59	0.21	4.45	266.2	247.83	18 37	1.09	3.30	0.56
Second whey	92.54	7.46	0.56	1.03	0.61	0.30	4.96	7.8	7.22	0.58	0.04	0.08	0.02
Third whey	89.29	10.71	1.04	0.99	5.25	......	3.43	3.5	3.13	0.37	0.04	0.03	......
Cheese, green	......	......	......	......	......	......	......	38.6	......	......	......	......	......
Cheese, seven days	33.68	66.32	35.32	24.32	3.45	0.64	......	37.3	12.56	24.74	13.17	9.07	0.24
Cheese, twenty-one days	33.36	66.64	36.47	24.84	3.76	0.73	......	36.6	12.21	24.39	13.35	9.09	0.27
Cheese, thirty-five days	33.20	66.80	35.98	25.08	5.29	0.54	......	36.06	11.97	24.09	12.97	9.04	0.19

SIXTH EXPERIMENT.

1. *Date.*— October 8, 1891.

2. *Kind of cheese.*— Cheddar.

3. *Description of milk used.*— Morning milk, 48 hours old, 24.81 pounds, from which were taken 5.31 pounds of cream, the cream alone being used for the experiment; evening milk, 36 hours old, 52.56 pounds; morning milk, 24 hours old, 72.75 pounds, from which were taken 15.88 pounds of cream, all the cream and 40 pounds of the skim-milk being used; evening milk, 12 hours old, 127.13 pounds; fresh morning milk, 68.68 pounds; "starter," eight pounds. Total amount of whole milk, skim-milk and cream used for this experiment, 317.56 pounds.

4. *Details of process of manufacture.*— Temperature of milk at beginning, 61° F.; commenced to heat at 9.30 A. M.; temperature of 84° F. reached at 10; "starter" added at 10; three-fourths of an ounce of rennet-extract added at 10.20; milk began to thicken at 10.31; commenced to cut curd at 10.40, and to stir at 10.47; commenced to heat again at 11; temperature of 97° F. reached at 11.55; whey drawn from curd at 12.30 P. M.; curd drained until 3.30; 0.81 pounds of salt added at 3.30; curd ground at 3.40 and put to press at 4.05. Amount of green cheese, 41.56 pounds.

ANALYSES CONNECTED WITH THE SIXTH EXPERIMENT.

	COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							COMPOSITION EXPRESSED IN POUNDS.					
	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of ash.	Per cent. of lactic acid.	Per cent. of sugar.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of lactic acid.
Milk	85.72	14.28	4.73	3.53	0.93	......	5.09	317.56	272.21	45.35	15.02	11.21	......
First whey	92.92	7.08	0.39	0.75	0.54	0.16	5.24	249.47	231.81	17.66	0.97	1.87	0.40
Second whey	92.04	7.96	0.19	1.12	0.69	0.25	5.71	16.00	14.73	1.27	0.03	0.18	0.04
Third whey	......	......	......	......	....	......	......	4.78	......	......	......	......	......
Cheese, green	37.60	62.40	33.53	21.91	3.11	0.62	......	41.56	15.63	25.93	13.93	9.10	0.26
Cheese, seven days	38.00	62.00	34.81	21.47	2.97	0.52	......	40.42	15.36	25.06	14.07	8.68	0.21
Cheese, twenty-one days	36.13	63.87	34.89	23.56	5.14	0.56	......	39.30	14.20	25.10	13.71	9.26	0.22
Cheese, thirty-five days	37.88	62.12	34.79	22.10	4.40	0.54	......	38.47	14.57	23.90	13.38	8.50	0.20

SEVENTH EXPERIMENT.

1. *Date.*— September 23, 1891.

2. *Kind of cheese.*— Stirred-curd, using home-made rennet-extract.

3. *Description of milk used.*— Morning milk, 24 hours old, 67.75 pounds; evening milk, 12 hours old, 243.88 pounds; "starter," 4.67 pounds. Total amount of milk used in this experiment, 316.3 pounds.

4. *Details of process of manufacture.*— Temperature of milk at beginning, 72° F.; commenced to heat at 9 10 A. M.; temperature of 82° F. reached at 9.35; "starter" added at 9.35; *one-sixth of whole solution prepared fresh from one rennet* added at 9.45; milk began to thicken at 9.55; commenced to cut curd at 10.04; and to stir at 10.12; commenced to heat again at 10.25; temperature of 97° F. reached 11.20; whey drawn from curd at 1.15 P. M.; curd drained until 1.45; 0.63 pounds of salt added at 1.45; curd put to press at 3.10. Amount of green cheese, 38.8.

Analyses Connected with the Seventh Experiment.

	Composition Expressed in Parts Per Hundred.							Composition Expressed in Pounds.					
	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of ash.	Per cent. of lactic acid.	Per cent. of sugar.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of lactic acid.
Milk	86.31	13.69	4.80	3.24	1.03	......	4.62	316.3	273.0	43.30	15.18	10.25	......
First whey	92.56	7.44	0.40	0.92	1.20	0.25	4.67	252.0	233.25	18.75	1.01	2.32	0.63
Second whey	92.06	7.94	0.77	1.03	1.37	0.39	4.38	15.80	14.55	1.25	0.12	0.16	0.06
Third whey	87.12	12.88	0.69	1.26	6.55	......	4.38	6.68	5.82	0.86	0.05	0.08	......
Cheese, green	......	......	......	......	......	......	......	38.80	......	......	......	......	......
Cheese, seven days	35.89	64.11	38.61	21.41	2.80	0.70	......	37.75	13.48	24.07	14.50	8.04	0.26
Cheese, twenty-one days	35.67	64.33	38.82	22.55	2.70	0.65	......	36.09	12.87	23.22	14.01	8.14	0.23
Cheese, thirty-five days	36.05	63.95	39.50	23.53	3.11	0.62	......	35.19	12.68	22.51	13.90	8.28	0.21

EIGHTH EXPERIMENT.

1. *Date.*— September 21, 1891.

2. *Kind of cheese.*— Stirred-curd.

3. *Description of milk used.*— Cream 60 hours old, 43 pounds cream, 48 hours old, 12 pounds; cream, 24 hours old, 9 pounds morning milk, 24 hours old, 29 pounds; cream, 12 hours old, 10 pounds; evening milk, 12 hours old, 237 pounds. Total amount of milk and cream used in this experiment, 340 pounds.

4. *Details of process of manufacture.*— Temperature of milk at beginning, 65° F.; commenced to heat at 9.28 A. M.; temperature of 82° F. reached at 9.52; $1\frac{1}{3}$ ounces of rennet-extract added at 9.53; milk began to thicken at 10.03; commenced to cut curd at 10.12 and to stir at 10.18; commenced to heat again at 10.30 temperature of 97° F. reached at 11.25; whey drawn from curd at 1 P. M.; curd drained until 1.35; 1.2 pounds of salt added; curd put to press at 3.30. Amount of green cheese 46.7 pounds.

ANALYSES CONNECTED WITH THE EIGHTH EXPERIMENT.

	COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							COMPOSITION EXPRESSED IN POUNDS.					
	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of ash.	Per cent. of lactic acid.	Per cent. of sugar.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of lactic acid.
Milk	83.90	16.10	6.49	3.37	0.67	......	5.57	340.00	285.26	54.74	22.07	11.46	......
First whey	93.14	6.86	0.76	0.96	0.63	0.20	4.31	267.10	248.78	18.32	2.03	2.56	0.53
Second whey	92.86	7.14	0.57	1.18	0.71	0.29	4.39	9.40	8.73	0.67	0.05	0.12	0.03
Third whey	85.17	14.83	4.81	0.87	3.89	......	5.26	7.25	6.17	1.08	0.35	0.07	......
Cheese, green	......	......	......	......	......	......	......	46.70	......	......	......	......	......
Cheese, seven days	31.95	68.05	43.53	17.28	3.22	0.58	......	45.10	14.41	30.69	19.63	7.79	0.26
Cheese, twenty-one days	32.35	67.65	44.94	17.86	2.92	0.72	......	43.50	14.07	29.43	19.55	7.76	0.31
Cheese, thirty-five days	32.23	67.77	45.36	18.45	3.61	0.51	......	42.56	13.72	28.84	19.30	7.85	0.22

NINTH (FACTORY) EXPERIMENT.

On September twenty-fifth, Mr. G. A. Smith superintended the making of cheese at the factory of Mr. G. Merry at Verona, N. Y. A small cheese made from the lot of milk was sent to the Station by Mr. Merry. Mr. Smith tested the milk and whey for fat by the Babcock test and sent samples of milk, whey and curd to the Station for analysis; but owing to long delay in reaching the Station, the samples of milk and whey were not in a fit condition to yield satisfactory results. The curd was analyzed, also the cheese at three and five weeks. The results which are, of necessity, fragmentary, are given here:

1. *Date.*— September 25, 1891.
2. *Kind of cheese.*— Cheddar.
3. *Description of milk used.*— Mixed factory milk, 3,200 pounds.
4. *Details of process of manufacture.*— Rennet added at 8.31 A. M.; curd cut at 9.05; commenced to heat second time at 9.20; temperature of 99° F. reached at 10.20; whey drawn from curd at 12.20 P. M.; curd ground and salted at 3.40; eight pounds of salt added.

ANALYSES CONNECTED WITH FACTORY EXPERIMENT.

	COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							COMPOSITION EXPRESSED IN POUNDS.					
	Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of ash.	Per cent. of lactic acid.	Per cent. of sugar.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of lactic acid.
Milk	......	......	3.70	. ...	......	......	......	3200.0	......	......	118.4	......	......
Whey	......	......	0.30	......	......	......	......	*2870.0	......	......	8.6	......	......
Curd	38.49	61.51	33.14	22.74	4.07	0.53	5.80	......	......	......	......	......	......
Cheese, three weeks	35.26	64.74	34.62	25.08	3.27	0.65	......	*317.7	112	205.7	109.9	79.7	2.06
Cheese, five weeks	35.67	64.33	34.49	25.33	1.81	0.59	......	311.4	111	200.4	107.4	78.9	1.84

* Estimated.

TABULATED STATEMENT OF THE PRINCIPAL CONDITIONS OF MANUFACTURE.

NO. OF EXPERIMENT.	Temperature of milk at start.	Time taken to heat to 85° F.	Time from adding rennet to cutting curd.	Time taken to heat to 98° F. after cutting and stirring.		Time from reaching 98° F. to drawing whey.		Time from drawing whey to salting.		Time from salting to putting in press.		Time of whole operation.	
	Deg.	Min.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min
1	60	35	20		25	1	36		59	1	05	6	00
2	65	41	20		45		55	1	40	1	15	6	21
3	77	16	14	1	16		45	1	20	2	05	6	16
4	61	35	18		53	1	22	2	55		15	7	05
5	63	25	23		58	1	51	1	00	1	40	6	40
6	61	30	20		55		35	3	00		10	6	10
7	72	25	19		55	1	55		30	1	25	9	00
8	65	24	19		55	1	35		35	1	55	6	02
9	....	....	34	1	00	2	00	3	00	......		.....	

In comparing some of the more important conditions of manufacture in the different experiments, we note the following among some of the interesting points:

1. The time in which the casein was coagulated by the rennet sufficiently to cut was quite uniform in the Station experiments; it averaged about nineteen minutes, in six of the experiments the variation being not over one minute from this average. The home-made rennet-extract coagulated the casein in nineteen minutes

2. The time required to heat the curd and whey to about 98° F. after cutting and stirring averaged about fifty-three minutes, in five of the experiments the variation being within five minutes of this time.

3. The time from reaching the temperature of 98° F. to drawing the whey averaged about an hour and twenty-three minutes, the variation from this average being from thirty-eight minutes below to thirty-two minutes above. This portion of the operation appears to have been less under the control of the maker than the preceding conditions.

4. The time from drawing whey to salting curd averaged, in the case of the stirred-curd process, about one hour, with a variation from thirty minutes below to forty minutes above. In the Cheddar process, the time was about three hours and was quite uniform.

5. The time from salting curd to putting it to press varies, in the stirred-curd process, from one hour and five minutes to two hours and five minutes, the average being one hour and thirty-four minutes. In the Cheddar process the time was only ten or fifteen minutes.

6. The time occupied by the whole operation of cheese-making from the beginning to the end varies from six to seven hours, the average being six hours and twenty minutes. In six of the experiments the extreme variation was about twenty minutes, the average being six hours and eight minutes.

7. From an examination and comparison of the data, it appears that the time which the rennet takes to act upon the casein is independent of the amount of total solids, fat, or nitrogen compounds. The rapidity of action of rennet probably depends upon (1st) the amount of rennet used, (2d) the temperature of the milk, and (3d) the degree of ripeness of the milk.

FLAVOR AND TEXTURE OF CHEESE.

When the stirred-cured cheeses were about one month old and the Cheddars were about fifteen days old, they were sampled and examined by Mr. Geo. A. Smith. Though the description is general and may not mean much to one unacquainted with cheese, it will have a fairly definite meaning for those who are accustomed to examining cheese. The numbers correspond to the experiments as already given.

1. Flavor, mild; texture, good, but rather dry.

2. Flavor, mild; texture, fine and dry.

3. Flavor, perfect; texture, fine.

4. Flavor, good, but not acid enough for a fine shipping cheese; texture, dry but loose.

5. Flavor, good; texture, good.

6. Flavor, perfect; texture, fine, close, solid.

7. Flavor, perfect, like fine butter; texture, perfect; a very fine shipping cheese, best of lot. Would be classed by shipper as a fancy September cheese.

8. Flavor, very good; texture, very silky; a fine-eating cheese.

LOSS OF MILK CONSTITUENTS IN CHEESE-MAKING.

Under this head the following points will be discussed:

1. Amount of fat recovered and lost in making cheese.
2. Amount of casein and albumen recovered and lost in making cheese.
3. Relation of albumen to casein in milk.
4. Influence of relation of fat to casein and albumen in milk on loss of these compounds in cheese-making.
5. Summary of results.

AMOUNT OF FAT RECOVERED AND LOST IN MAKING CHEESE.

Method of making calculations.—In ascertaining the amount of fat lost and recovered in cheese-making, two methods may be employed. First, the amount of fat in the three wheys represents the loss, and this amount subtracted from the amount of fat in the milk represents the amount of fat recovered in the cheese. This method makes no allowance for loss of material in handling, but loss from this source is so slight as to make little or no appreciable difference in the results. The second method of calculating the loss of fat is to take the amount of fat found in the cheese by analysis, which is the amount recovered, and subtract this from the amount of fat in the milk; the difference represents the amount of fat lost. The results obtained by these two methods should agree, one serving as a check upon the other, if there were no source of error in the analysis of the cheese; but, as previously pointed out, it is extremely difficult to sample a cheese in such a way that the sample analyzed shall represent the composition of the whole cheese, unless we cut up the cheese. Consequently, the results of loss and recovery of fat, as obtained by these two methods of calculation, do not agree closely, as a rule. The method adopted as giving the more satisfactory results is the first; that is, taking the fat in the wheys as representing the loss. This substracted from the fat in the milk gives the amount of fat recovered in the *green cheese.* The amount of fat in a marketable cheese, three to five weeks old, is, under ordinary circumstances, somewhat less than in the green cheese, but, for purposes of comparison in regard to the loss of fat in making cheese, the method adopted gives satisfactory results. The loss of fat in the process of ripening will be noticed later.

In the following table, the amounts of fat lost and recovered are presented in two ways; first, the number of pounds of fat lost and recovered in 100 pounds of milk is given; second, the proportion of fat in milk lost and recovered is given; that is, the pounds of fat lost and recovered for 100 pounds of fat in the milk. Taking the first experiment, for example, the amount of fat in the milk is 2.35 pounds in 100 pounds of milk; of this amount, .154 pounds are lost or 6.55 per cent of the whole amount of fat in the milk. That is the same as saying that, if from 2.35 pounds of fat in milk, .154 pounds of fat are lost, then from 100 pounds of fat in milk, 6.55 pounds would be lost. As previously stated, the balance remaining after taking out the amount lost is assumed to be the amount recovered in the green cheese.

TABLE SHOWING AMOUNT OF FAT LOST AND RECOVERED IN MAKING CHEESE.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in 100 lbs. of milk.	Pounds of fat recovered in 100 lbs of milk.	Pounds of fat lost in whey from 100 lbs. of fat in milk.	Pounds of fat recovered in green cheese from 100 lbs. of fat in milk.
1..........	2.35	0.154	2.196	6.55	93.45
2..........	3.01	0.1 3	2.817	6.42	93.58
3..........	3.88	0.277	3.603	7.15	92.85
4..........	3.96	0.283	3.677	7.14	92.86
5..........	4.70	0.359	4.341	7.64	92.36
6..........	4.73	0.331	4.399	6.99	93 01
7..........	4.80	0.373	4.427	7.77	92.23
8..........	6.49	0.715	5.775	11.01	88.99
9..........	3.70	0.269	3.431	7.26	92.74

STATEMENT OF RESULTS.

In examining the above table, we notice the following points of interest:

1. The amount of fat lost in the whey increases gradually, but not uniformly, as the amount of fat in the milk increases.

If we take the fat in the first milk as unity and also the amount of fat lost as unity, and arrange the succeeding numbers on this basis, we can trace the relation between the increase of loss and the increase of fat in the milk.

	NUMBER OF EXPERIMENT.							
	1	2	3	4	5	6	7	8
Increase of fat in milk	1	1.28	1.65	1.68	2.00	2.01	2.04	2.76
Increase of loss of fat in whey	1	1.25	1.80	1.84	2.33	2.15	2.42	4.64
Difference between above	0	0.03	0.15	0.16	0.33	0.14	0.38	1.88

Calling the amount of fat in the first milk *one*, the amount of fat in the second is 1.28 times that in the first; the fat in the third is 1.65 times that in the first, etc. Calling the amount of fat lost in the whey in the first experiment *one*, the amount of fat lost in the second is 1.25 times that in the first; the fat lost in the third is 1.80 times that lost in the first, etc. If the increase of loss were uniform with the increase of fat in the milk, the two sets of numbers would be the same. In the second experiment, both numbers would be 1.28, if the loss were uniform with the increase of fat in the milk. Instead of 1.28, the loss is 1.25, so that the increase of loss is not quite so large as the increase of fat in the milk. In the remaining experiments, the increase of loss of fat is greater in proportion than the increase of fat in the milk, the relation between the two sets of numbers tending to grow wider apart as the fat in the milk increases. Leaving out the sixth experiment, the increase in loss is relatively in excess of the increase of fat in the milk by a steadily increasing amount.

2. The average amount of fat lost in the nine experiments is 0.329 pounds in 100 pounds of milk; excluding the eighth experiment, the average loss of fat for 100 pounds of milk is 0.28 pounds; or taking only the second, third and fourth experiments, which most closely represent factory milk, the loss of fat is 0.25 pounds, for each hundred pounds of milk. If the same milk were made into butter, the loss of fat would be considerably greater than the above, unless the best dairy appliances and highest skill were used.

3. Basing a comparison of loss of fat in the different experiments upon 100 pounds of fat in the milk, we notice that the loss is least in the second experiment, although the milk in this case

contains more fat than in the first experiment. No definite cause can be given for this apparent discrepancy; we should expect a greater proportion of loss in the second experiment. The larger proportion of loss in the first experiment was probably due to some unknown condition in some part of the process of manufacture. A similar apparent exception to the general tendency occurs in the sixth experiment, where the proportion of fat lost is less than in the fifth or seventh experiments, though the fat in the milk of these three experiments is nearly the same. The difference here may be due to the fact that, in the sixth experiment, the Cheddar process was used, while the stirred-curd process was used in the other two cases.

The increase of relative loss of fat is not great, until we get to milk containing over four pounds of fat in 100 pounds of milk; and, even in the first seven experiments, the difference of loss, between the highest and lowest cases, is only 1.35 pounds for 100 pounds of fat in the milk.

4. The average loss of fat in all the experiments is about 7.55 pounds of fat for every hundred pounds of fat in the milk, the average amount of fat in all the milks being 4.18 pounds of fat in 100 pounds of milk. Omitting the eighth experiment, the average number of pounds of fat per hundred pounds of milk is 3.89 while the loss of fat averages 7.1 pounds for 100 pounds of fat in milk. Taking the average of the second, third and fourth experiments, which more nearly represent average factory milk, the amount of fat in 100 pounds of milk is 3.62, and the average loss of fat is 6.9 pounds for 100 pounds of fat in milk.

5. In the comparison made between the *stirred-curd* and *Cheddar* processes, the amount of fat lost in the third and fourth experiments is practically the same, the fat in the milk being nearly the same in amount. In the fifth, sixth and seventh experiments, when the fat in the milk was about the same, being between 4.7 and 4.8 per cent., the Cheddar process gave considerably better results. That the difference in favor of the Cheddar process in this case was due to the Cheddar process, we can not say; changes, due to other conditions in the process of manufacture, may have made the difference. Before we can draw any definite conclusions in regard to loss of fat in the Cheddar process

as compared with the stirred-curd, many other experiments will be needed.

6. As regards the use of commercial rennet-extract and the home-made rennet-extract, the fifth and seventh experiments show practically no difference as regards the amount of fat lost.

AMOUNT OF CASEIN AND ALBUMEN RECOVERED AND LOST IN MAKING CHEESE.

It has already been stated that casein is coagulated by rennet and albumen is not. In cheese-making, it is probable that some of the casein is lost in the whey, while some of the albumen is retained mechanically in the cheese in the same way that water is retained. So, in the cheese, we have most of the casein and a small portion of the albumen, while, in the whey, we have most of the albumen and a small portion of casein. Future experiments will be made to determine the amount of casein and albumen separately in the whey. The presence of albumen in green cheese to the extent of one or two per cent was indicated by analysis, as will be noticed later.

In the table presented below, the figures representing the amount of casein recovered in the green cheese and lost in the whey are obtained in the manner already explained in connection with the loss and recovery of fat.

TABLE SHOWING AMOUNT OF CASEIN AND ALBUMEN RECOVERED AND LOST IN MAKING CHEESE.

NUMBER OF EXPERIMENT.	Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein and albumen recovered in 100 pounds of milk.	Pounds of casein and albumen lost in 100 pounds of milk.	Pounds of casein and albumen lost in whey from 100 pounds of casein and albumen in milk.	Pounds of casein and albumen recovered in cheese from 100 pounds of casein and albumen in milk.
1..........	3.34	2.63	0.71	21.17	78.83
2..........	2.81	2.31	0.50	17.91	82.09
3..........	3.45	2.52	0.93	27.06	72.94
4..........	3.81	2.89	0.92	24.18	75.82
5..........	3.91	2.86	1.05	26.78	73.22
6..........	3.53	2.90	0.63	17.93	82.07
7..........	3.24	2.43	0.81	24.97	75.03
8..........	3.37	2.56	0.81	24.00	76.00

Statement of results.

1. The proportion of casein and albumen lost or recovered appears to bear no definite or fixed relation to the total amount of casein and albumen in the milk.

In the first and eighth experiments, the amount of casein and albumen in the milk is practically the same, but there is a difference of nearly three per cent. in the amount lost or recovered. In the third and sixth experiments, the casein and albumen in the milk is nearly the same in amount, while the difference in the amount lost or recovered is over nine per cent.

2. The average per cent. of casein and albumen in the milk in all the experiments is 3.43; the proportion of this amount that was lost averages twenty-three per cent. or twenty-three pounds for every 100 pounds of casein and albumen in the milk.

3. The use of commercial rennet-extract and home-made extract appears to show no difference as regards the amount of casein and albumen lost and recovered.

4. The variations shown in the proportion of casein and albumen lost and recovered are probably to be attributed to variation in details of manufacture.

RELATION OF ALBUMEN TO CASEIN IN MILK.

If we assume that the albumen is represented by the loss of nitrogen compounds, then it would appear that the relation of albumen to casein varies considerably. Blyth, an English authority, says: "The amount of albumen in milk is really fairly constant and averages .7 per cent. In healthy cows, it is a very constant quantity. According to the author's experience, the albumen preserves a very constant relation to the casein, the quantity of the latter being five times that of the albumen; so that, if either the amount of casein or albumen is known, the one may be calculated from the other with great accuracy." The foregoing statement has been quite generally accepted as true. However, from an examination of a large number of analyses of normal milk, reported by various men, where casein and albumen were determined separately, there appears to be considerable variation instead of uniformity. Some cases are reported where there was only one part of albumen to ten of casein; while, at the other extreme, there was one part of albumen to three of casein, while the average of a large number was one of albumen to six of casein.

If the loss in the above table represents albumen, then we have this compound varying from below 18 per cent. to over 27 per cent. of the nitrogen compounds; or, stated in another way, there is for the lowest, one part of albumen to 2.7 parts of casein and, for the highest number, one part of albumen to 4.6 parts of casein; in all the average is one part of albumen to 3.5 parts of casein. If the relation were, as Blyth states, one part of albumen to five of casein, then the loss in every hundred pounds of casein and albumen in milk would be less than 17 pounds, while in these experiments, the least loss is nearly 18 pounds and the greatest over 27 pounds. This can be explained by assuming that a definite amount of albumen, say 17 pounds, was lost, and that the variation from 18 to 27 pounds was caused by an additional loss of casein, varying in the different experiments. While these results are merely suggestive in regard to the relation of casein and albumen in the milk, it is evident that here is a field for investigation in the future. It is probably not sufficiently correct to assume that all the loss is albumen, but, doubtless, some casein and most of the albumen go into the whey, while most of the casein and some albumen go into the cheese; the amount of casein lost probably depends upon variation in the details of cheese-making.

In this connection, it may be stated that efforts have been made to recover the albumen in the cheese. Doubtless, most of the albumen can be recovered, but it remains to be seen what effect its presence in considerable quantities may have upon the keeping and other qualities of the cheese.

INFLUENCE OF RELATION OF FAT TO CASEIN AND ALBUMEN IN MILK ON LOSS OF THESE COMPOUNDS IN CHEESE-MAKING.

NUMBER OF EXPERIMENT.	Pounds of fat for one pound of casein and albumen in the milks used.	Pounds of fat lost in whey from 100 pounds of fat in milk.	Pounds of casein and albumen lost in whey from 100 pounds of casein and albumen in milk.
1	0.70	6.55	21.17
2	1.07	6.42	17.91
3	1.12	7.15	27.06
4	1.04	7.14	24.18
5	1.20	7.64	26.78
6	1.34	6.99	17.93
7	1.48	7.77	24.97
8	1.92	11.01	24.00

Statement of results.

1. An examination of the above table indicates, in a general way, that where the fat in the milk is large in amount as compared with the casein and albumen, the loss of fat in the whey is greater than where the fat and casein in the milk are more nearly alike.

Thus, in the first experiment, there is more casein and albumen than fat in the milk and the loss of fat is 6.55 per cent. The second experiment is exceptional to the general statement, also the fourth and sixth experiments. The seventh and eighth show the tendency in a quite marked degree. The lack of uniformity in the results may be accounted for by variations in the details of manufacture, independent of the relation of the fat to the casein and albumen in the milk.

We should expect such a tendency, for, when the proportion of casein and albumen is larger, more fat will be held in the curd and less loss in the whey, provided the treatment in manufacture is the same.

The loss of fat would not have been so large in the milks that contained the higher percentage of fat, had those milks been normal. Thus, in a normal milk containing 6.49 per cent of fat, there would be about 1.44 pounds of fat to one pound of casein and albumen, but in the milk used, there were nearly two pounds of fat to one of casein and albumen. As already stated, the amount of casein and albumen in the different milks was fairly constant, while the fat varied greatly, and the casein was, in the extreme cases, insufficient to hold the fat as completely as in the other cases.

2. The relation of fat to casein and albumen in milk does not appear to be, in any way, connected with the amount of casein and albumen lost. In the second and sixth experiments, the loss of albumen and casein is the same, but there is, in the latter case, much more fat for the same amount of casein and albumen.

SUMMARY OF RESULTS RELATING TO LOSS OF MILK-CONSTITUENTS IN CHEESE-MAKING.

1. *Fat.*

a. The actual amount, as well as the proportion, of milk-fat lost in the whey increased gradually, but not uniformly, when the amount of fat in the milk increased.

b. The average amount of fat lost in the whey in all the experiments was about one-third of a pound for 100 pounds of milk, which was about 7.5 per cent. of the milk-fat. Taking only those experiments which most nearly represented average factory milk, the average amount of milk-fat lost was one-quarter of a pound for 100 pounds of milk, which was nearly seven per cent. of the milk-fat.

c. While it was true that the loss of fat increased, both absolutely and relatively, when the amount of fat in the milk increased, it was not true that all the additional fat above four per cent., or even above five and one-half per cent., was lost in the whey.

2. *Casein and albumen.*

a. The amount of casein and albumen lost appeared to bear no definite relation to the total amount of casein and albumen in the milk.

b. The average amount of casein and albumen in the milk in the eight experiments was 3.43 pounds per hundred pounds of milk; of this amount, about twenty-three per cent. or about 0.8 pounds were lost.

c. The irregular variations in the proportion of casein and albumen lost were probably due to variations in the conditions of manufacture.

3. *Loss of fat and of casein and albumen in cheese-making as influenced by proportion of fat to casein and albumen in milk.*

a. When the amount of casein and albumen in the milk was nearly the same as, or greater than, the amount of fat, the loss of fat was least. When the amount of fat became considerably greater than the amount of casein and albumen, then the loss of fat increased. Comparatively large proportions of casein served to hold the fat more completely in the curd, as would be expected.

b. The amount of fat in the milk appeared, in no way, to have any influence on the amount of casein and albumen lost in the process of manufacture.

VI. INFLUENCE OF COMPOSITION OF MILK ON COMPOSITION OF CHEESE.

Under this head the following points will be considered:

1. Influence of fat in milk on composition of cheese.
2. Influence of casein and albumen in milk on composition of cheese.
3. Influence of relation of fat to casein and albumen in milk on composition of cheese.
4. Summary of results.

INFLUENCE OF FAT IN MILK ON COMPOSITION OF CHEESE.

It might, perhaps, be assumed that the amount of fat in a cheese is largely dependent upon the amount of fat in the milk from which the cheese is made. This would, of course, be modified by the amount of fat that is lost in making, also by the amount of water in the cheese, which depends upon the process of manufacture; the amount of casein in the cheese would also have some influence.

The figures representing the pounds of fat, water, etc., in the table below are obtained by averaging the different analyses of each cheese.

TABLE SHOWING RELATIONS OF FAT IN MILK TO COMPOSITION OF CHEESE.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 lbs. of milk.	Pounds of fat in 100 lbs. of cheese.	Pounds of water in 100 lbs. of cheese.	Pounds of casein in 100 lbs. of cheese.
1	2.35	23.7	42.0	27.6
2	3.01	30.6	37.0	25.0
3	3.88	34.5	34.8	24.9
4	3.96	30.4	37.8	23.5
5	4.70	35.9	33.4	24.7
6	4.73	34.5	37.4	22.3
7	4.80	39.0	35.9	22.5
8	6.49	44.6	32.2	17.9
9	3.70	34.6	35.5	25.2

Statement of results.

1. The amount of fat in a cheese tends to increase, but not uniformly, when the amount of fat in the milk increases.

An examination of the above table shows that in the first, second, third, fifth, seventh and eighth experiments the above statement holds good.

If we take the amount of fat in the first milk as *one*, and the amount of fat in 100 pounds of the first cheese as *one*, and arrange the succeeding numbers on this basis, we can trace the general relation between the increase of fat in the milk and the increase of fat in the cheese.

	NUMBER OF EXPERIMENT.							
	1	2	3	4	5	6	7	8
Increase of fat in milk	1	1.28	1.65	1.68	2.00	2.01	2.04	2.76
Increase of fat in cheese	1	1.29	1.45	1.28	1.51	1.45	1.64	1.88
Difference between above.	....	0.01	0.20	0.40	0.49	0.56	0.40	0.88

Calling the amount of fat in 100 pounds of milk *one*, the amount of fat in the second is 1.28 times that in the first; the fat in the third is 1.65 times that in the first, etc. Calling the amount of fat in 100 pounds of cheese *one*, in the first experiment, the amount of fat in the second is 1.29 times that in the first; the amount of fat in 100 pounds of the third cheese is 1.45 times that in the first, etc. If the increase of fat in the cheese were uniform with the increase of fat in the milk, the two sets of numbers would be the same. In the second experiment, both numbers would be 1.28, if the increase of fat in the cheese were uniform with the increase of fat in the milk. Instead of 1.28, the increase of fat in the cheese is represented by 1.29; that is, the cheese contains a little more fat than we should expect, if the increase were uniform. In the other experiments, the difference is in the other direction; that is, the fat in the cheese does not increase as rapidly in proportion as does the fat in the milk, the relation between the two sets of numbers tending to grow wider apart as the fat in the milk increases.

2. In the fourth and sixth experiments, in which the Cheddar process was used, we notice that the fat in the cheese is considerably less than in the corresponding experiments, in which the stirred-curd process was employed. The Cheddar process appears to make cheese containing more water and proportionately less fat.

3. Milk containing less than three per cent. of fat would, on the basis of these experiments, make a cheese containing less than thirty per cent of fat. Such a cheese would be below the standard required by law in Wisconsin.

Influence of Casein and Albumen in Milk on Composition of Cheese.

The figures in the last two columns of the table below are obtained by averaging the different analyses of each cheese.

Table Showing Amount of Casein and Albumen in Milk and in Cheese.

NUMBER OF EXPERIMENT.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein and albumen in cheese from 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of cheese.
1	3.34	2.56	27.6
2	2.81	2.27	25.0
3	3.45	2.57	24.9
4	3.81	2.75	23.5
5	3.91	2.78	24.7
6	3.53	2.80	22.7
7	3.24	2.58	22.5
8	3.37	2.29	17.9

Statement of results.

A study of the data in the above table does not reveal any direct or uniform relation between the amount of casein and albumen in milk and the proportion of casein and albumen in 100 parts of cheese. The amount of casein and albumen in the milk is fairly constant, varying only a little over one pound per hundred pounds of milk in all the experiments, from 2.81 to 3.91; and the actual number of pounds of casein and albumen in cheese made from 100 pounds of milk varies only from 2 27 to 2.80 pounds, a little over one-half of a pound. But we see that the proportion of casein and albumen in 100 pounds of cheese varies from 27.6 pounds in the first to 17.9 in the last experiment, a variation of nearly ten pounds. We can, therefore, perceive no relation between the composition of the milk and the composition of the cheese in respect to casein and albumen, if we consider these constituents by themselves. Since we have already seen how preponderating an influence the fat in the milk exercises on the composition of the cheese, we must study the influence of casein and albumen in milk on the composition of cheese in connection with the fat in the milk and in the cheese.

INFLUENCE OF RELATION OF FAT TO CASEIN AND ALBUMEN IN MILK ON COMPOSITION OF CHEESE.

Rearranging data already presented in previous tables we have the following table:

NUMBER OF EXPERIMENT.	Pounds of casein and albumen in cheese from 100 lbs. of milk.	Pounds of fat in cheese from 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of cheese.	Pounds of fat in 100 lbs. of cheese.	Pounds of fat for one lb. of casein and albumen in milk.
1..........	2.56	2.20	27.6	23.7	0.70
2..........	2.27	2.73	25.0	30.6	1.07
3..........	2.57	3.56	24.9	34.5	1.12
4..........	2.75	3.56	23.5	30.4	1.04
5..........	2.78	4.04	24.7	35.9	1.20
6..........	2.80	4.33	22.7	34.5	1.34
7..........	2.58	4.47	22.5	39.0	1.48
8..........	2.29	5.73	17.9	44.6	1.92

In examining the above table, we notice the following facts:

1. The pounds of casein and albumen in the cheese from 100 pounds of milk is fairly constant, varying only about one-half of a pound in all the experiments.

2. The pounds of fat in the cheese from 100 pounds of milk constantly increases from the first to the last experiment, increasing from 2.20 to 5.73 pounds, a variation of over 3.5 pounds.

3. Since the amount of fat constantly increases and the amount of casein and albumen remains nearly the same, there will be in the different cheeses less casein and albumen in proportion to the fat; that is, the amount of casein in 100 pounds of cheese will decrease, relatively, as the amount of fat increases. This is clearly indicated in the fourth and fifth columns of the above table.

4. The proportion of casein and albumen in cheese depends upon the amount of casein and albumen relative to the amount of fat in the milk, and not upon the amount of casein and albumen taken alone. Thus, in the first experiment, the amount of casein and albumen in the milk is 3.34 pounds per hundred, while the fat is only 2.35 pounds in amount; that is, for one pound of casein and albumen in milk, there is only .7 pounds of fat. In the cheese made from this milk we find the amount of casein highest of all. In the eighth experiment, the amount of casein and albumen is about the same as in the first case; the amount of fat, however, is nearly twice as much, and, in the cheese made from this milk, we find the amount of casein and albumen least. A comparison of the fourth and last columns in the above table shows clearly that as the amount of fat in the milk increases relative to the casein and albumen, the proportion of casein and albumen in the cheese diminishes.

While we can say, roughly, what per cent. of fat cheese will contain, if we know the per cent. of fat in a normal milk, we can not tell at all what per cent. of casein and albumen cheese will contain from knowing only the per cent. of these constituents in the milk.

5. Attention is called to the fact that the highest amount of casein in any cheese is 27.6 pounds per hundred, and this was made from milk containing a proportion of ten pounds of casein

and albumen to seven pounds of fat, a large excess of casein and albumen, which would not be found often in normal milk. It is often stated that good cheese should consist of about one-third water, one-third fat and one-third casein. If this statement is true, the inquiry is pertinent here, what kind of milk would be required to make cheese consisting of one-third casein, when milk containing less than 2.5 per cent. fat, with an excess of casein and albumen, makes cheese containing less than twenty-eight per cent. of casein?

SUMMARY OF RESULTS RELATING TO INFLUENCE OF COMPOSITION OF MILK ON COMPOSITION OF CHEESE.

1. *Fat.*

a. The proportion of fat in the cheese showed a tendency to increase, but not uniformly, when the amount of fat in the milk increased. There were about twenty-four pounds of fat in 100 pounds of cheese made from the skim-milk, while 100 pounds of the cheese made from the milk richest in fat contained about forty-five pounds of fat.

b. Under the conditions of manufacture employed, cheese containing thirty pounds of fat per hundred pounds of cheese could not be made from milk containing less than three per cent. of fat.

c. The fat exercised a greater influence on the composition of the cheese than any other constituent of the milk.

2. *Casein and albumen.*

a. There appeared to be no relation between the amount of casein and albumen in the milk and the amount of casein and albumen in 100 pounds of cheese.

3. *Composition of cheese as influenced by the proportion of fat to casein and albumen in milk.*

a. When the casein and albumen were present in the milk in largest quantities relative to the fat, the proportion of casein was greatest in the cheese; and when the fat in the milk was greatest relative to the casein and albumen, the casein in the cheese was least.

VII. INFLUENCE OF COMPOSITION OF MILK ON YIELD OF CHEESE.

Under this head, we shall consider the following subjects:

1. Influence of fat in milk on yield of cheese.
2. Influence of casein and albumen in milk on yield of cheese
3. Amount of milk required to make one pound of cheese.
4. Summary of results.

INFLUENCE OF FAT IN MILK ON YIELD OF CHEESE.

In the following table, the amount of cheese made from 100 pounds of milk is calculated as cheese five weeks old. The figures under "pounds of fat in cheese from 100 pounds of milk" are based upon the average of all the analyses of each cheese.

TABLE SHOWING RELATION OF FAT IN MILK TO YIELD OF CHEESE.

NUMBER OF EXPERIMENT.	Pounds of marketable cheese made from 100 lbs. of milk.	Pounds of fat in 100 lbs. of milk.	Pounds of fat in cheese from 100 lbs. of milk.	Pounds of casein, water, etc., in cheese from 100 lbs. of milk.
1	9.05	2.35	2.20	6.85
2	8.86	3.01	2.73	6.13
3	10.11	3.88	3.56	6.55
4	11.25	3.96	3.56	7.69
5	11.07	4.70	4.04	7.03
6	12.12	4.73	4.33	7.79
7	11.12	4.80	4.47	6.65
8	12.52	6.49	5.73	6.79

Statement of results.

1. In the experiments described in this report, the increase in the yield of cheese was due to increase of fat in milk more than to any other constituent of the milk.

In the foregoing table, it is noticeable that the yield of cheese increases, in most cases, when the fat in the milk increases. Is this increase of yield in cheese due alone to increase of fat in milk? We can answer this question more clearly by rearranging the data presented in the above table, in the following manner:

NUMBER OF EXPERIMENT.	YIELD OF CHEESE FROM 100 LBS. OF MILK.		Pounds of fat in cheese from 100 lbs. of milk.—Increase of fat in cheese.	POUNDS OF CASEIN, WATER, ETC., IN CHEESE FROM 100 LBS. OF MILK.	
	Increase of yield.	Decrease of yield.		Increase.	Decrease.
1..........	......	......	......	......	....
2..........	......	0.19	0.53	......	0.72
3..........	1.06	......	1.36	......	0.30
4..........	2.20	......	1.36	0.84	....
5..........	2.02	......	1.84	0.18	....
6..........	3.07	......	2.13	0.94	....
7..........	2.07	......	2.27	......	0.20
8..........	3.47	......	3.53	......	0.06

The yield of cheese in the first experiment is taken as a starting point, and is compared with each following experiment; where the yield is greater than in the first cheese, the difference or increase is placed in the second column; where there is a less yield than in the first case, the difference or decrease is placed in the third column. Thus, in the second experiment, the yield was 0.19 pounds less than in the first; in the third the yield was 1.06 pounds greater than in the first; in the fourth, the yield of cheese was 2.20 pounds greater than in the first, etc. The next column gives the increase of fat in the cheese. Thus, the second cheese contained .53 pounds fat more than the first; the third, 1 36 pounds fat more than the first, etc. The last two columns show the difference of decrease and increase in amount of casein, water, etc., of the various cheeses as compared with the first. Thus, the second, third, seventh and eighth cheeses contain a smaller amount of casein, water, etc., than the first cheese, while the fourth, fifth and sixth cheeses contain more casein, water, etc., than the first.

Comparing the first and second experiments, we see that the yield of cheese diminished .19 pounds, while the fat increased .53 pounds Then we see that the casein, water, etc., decreased .72 pounds, so the loss in yield was due to an excessive loss of casein, water, etc., the increase of fat being insufficient to overcome the large loss of water, casein, etc.; hence there was a decrease in yield.

Comparing the first and third experiments, the yield of cheese increased 1.06 pounds, while the fat increased 1.36 pounds, and the other constituents decreased .30 pounds. Hence, in this case, the increased yield was entirely due to the increase of fat. The same is true in the seventh and eighth experiments as compared with the first; there was an actual decrease of the constituents not fat so that whatever increase there was, was due to increase of fat. In the fourth, fifth and sixth experiments, the increased yield of cheese was due to the increase of both fat and of other constituents, but the greatest part of the increase was due to increase of fat.

As already pointed out, the increase of fat in the cheese is due to increase of fat in the milk; hence the increase of yield of cheese, which has just been shown to be largely dependent upon increase of fat in the cheese, is largely dependent upon an increase of fat in milk.

It will be noticed that in the fourth and sixth experiments, in which the Cheddar process was used, the increase of yield was more largely due to increase in yield of constituents not fat than in any other case. To what extent this increase is due to casein, we will notice later.

Influence of Casein and Albumen in Milk on Yield of Cheese.

Number of experiment.	Pounds of marketable cheese made from 100 pounds of milk.	Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein and albumen in cheese from 100 pounds of milk.	Pounds of fat in cheese from 100 pounds of milk.	Pounds of water, ash, etc., in cheese from 100 pounds of milk.
1..........	9.05	3.34	2.56	2.20	4.29
2..........	8.86	2.81	2.27	2.73	3.86
3..........	10.11	3.45	2.57	3.56	3.98
4..........	11.25	3.81	2.75	3.56	4.94
5..........	11.07	3.91	2.78	4.04	4.25
6..........	12.12	3.53	2.80	4.33	4.99
7..........	11.12	3.24	2.58	4.47	4.07
8..........	12.52	3 37	2.29	5.73	4.50

1. The influence of the casein and albumen in the milk upon increase or decrease in yield of cheese is slight as compared with the influence of the fat.

While the above table does not show most clearly the truth of the foregoing statement, we can, by rearranging the data, present them in such a way as to show the fact stated.

NUMBER OF EXPERIMENT.	YIELD OF CHEESE FROM 100 POUNDS OF MILK.		POUNDS OF CASEIN AND ALBUMEN IN CHEESE FROM 100 POUNDS OF MILK.		Pounds of fat in cheese from 100 pounds of milk.—Increase of fat in cheese.	POUNDS OF WATER, ASH, ETC., IN CHEESE FROM 100 POUNDS OF MILK.	
	Increase of yield.	Decrease of yield.	Increase of casein in cheese.	Decrease of casein in cheese.		Increase of water, etc., in cheese.	Decrease of water, etc., in cheese.
1................	......	......	......	......	......	......	......
2................	......	0.19	......	0.29	0.53	......	0.43
3................	1.06	......	0.01	......	1.36	......	0.31
4................	2.20	......	0.19	......	1.36	0.65	......
5................	2.02	......	0.22	......	1.84	......	0.04
6................	3.07	......	0.24	......	2.13	0.70	......
7................	2.07	......	0.02	......	2.27	......	0.22
8................	3.47	......	......	0.27	3.53	0.21	......

In the foregoing table, the yield of cheese in the first experiment is taken as a starting point, and is compared with the yield in each of the following experiments; where the yield is greater than in the first cheese, the difference or increase is placed in the second column; where there is a yield less than in the first case, the difference or decrease is placed in the next column. Thus, in the second experiment, the yield of cheese was 0.19 pounds less than in the first; in the third the yield was 1.06 pounds greater than in the first; in the fourth case, the yield was 2.20 pounds greater than in the first case, etc. The fourth and fifth columns, in a similar manner, give the amount of increase or decrease of casein and albumen in each cheese, as compared with the first. Thus, the second and eighth cheeses contained less, while the others contained more casein and albumen than the first cheese. The sixth column gives the increase of fat in each cheese over the fat in the first cheese. The last two columns give, in a similar manner, the increase and decrease of the remaining constituents of the cheese, chief of which is water; the second, third, fifth and seventh cheeses contain less water, etc., than the first cheese, while the other cheeses contain more.

Comparing the first and second experiments, we see that the yield of cheese was diminished 0.19 pounds. This loss of yield was caused by a decrease of 0.29 pounds of casein and albumen and 0.43 pounds of water, etc. The fat increased 0.53 pounds, but the loss of the other constituents was 0.19 pounds greater than this gain of fat. If the casein had remained the same as in the first experiment, there would have been a slight increase in the yield of cheese. The decrease in the amount of casein was due to the fact that the milk contained about one-half a pound less of casein and albumen than in the first experiment. Though the decrease in casein and albumen here is considerable, it does not exercise so great an influence on the diminished yield of cheese as does the decrease of water.

Comparing the first and third experiments, the yield of cheese increased 1.06 pounds. Of this amount of increase, we can credit only .01 pounds to the casein and albumen, the rest being due to increase of fat; there was a decrease in water, etc.

If, in a similar manner, we compare each of the succeeding experiments with the first, we see, first, that the increase or decrease in yield of cheese is, in every case, dependent very much less upon the casein and albumen than upon the fat; and, second, that the amount of water exercises a greater influence on increase or decrease of yield of cheese than do the casein and albumen.

2. It will be noticed, that, in the fourth and sixth experiments, in which the Cheddar process was employed, there was an increased yield of cheese, due, more largely, than in other cases, to the increase of casein and albumen and water retained in the cheese.

AMOUNT OF MILK REQUIRED TO MAKE ONE POUND OF CHEESE.

The accompanying table states the amount of milk required to make one pound of cheese, taking each cheese when it is green and then when it is one, three and five weeks old. As a cheese loses weight from week to week, the amount of milk equivalent to one pound of the same cheese, as it becomes older and lighter, must become proportionately greater. Probably the figures under the fifth week after manufacture more nearly represent the condition of the cheese when it becomes marketable. The figures are based upon the actual weights of the cheese, no allowance being made for variation in the amount of water in the cheese. As will be noticed later, the loss of weight in the different cheeses is not quite uniform.

TABLE SHOWING POUNDS OF MILK REQUIRED TO MAKE ONE POUND OF CHEESE.

NUMBER OF EXPERIMENT.	When cheese was green.	When cheese was one week old.	When cheese was three weeks old.	When cheese was five weeks old.
1	10.23	10.50	10.79	11.05
2	10.34	10.71	11.01	11.29
3	9.15	9.48	9.69	9.89
4	8 19	8.42	8.70	8.89
5	8.44	8.73	8.90	9.03
6	7.64	7.85	8.08	8.25
7	8.16	8.38	8.76	8.99
8	7.28	7.54	7.81	7.99

From what has gone before, we can account for the changes in the amount of milk required to make one pound of cheese.

1. As a rule, less milk was required for one pound of cheese, when the amount of fat in the milk increased.

In the second experiment more milk is required than in the first, although the fat is greater in the second case. This, we have seen, is due to two facts, (1st) that the second milk contained less casein and albumen; and (2d) that the cheese in the second case retained a smaller proportion of water.

2. As between the third and fourth experiments, the fourth cheese made by the Cheddar process required less milk for a pound of cheese, because the resulting cheese contained a larger proportion of water; the fat recovered being the same in both experiments. In the sixth experiment, where the Cheddar process was also employed, the loss of fat was less, and also the cheese retained more water than in the case of the stirred-curd cheeses, made in experiments five and seven from milk containing approximately the same amount of fat.

SUMMARY OF RESULTS RELATING TO INFLUENCE OF COMPOSITION OF MILK ON YIELD OF CHEESE.

1. *Fat.*

a. The yield of cheese increased when the amount of fat in the milk increased, but not uniformly so.

b. In three experiments the increased yield of cheese was *wholly* due to increase of fat in the milk; while, in the other experiments, the increased yield was *mainly* due to increase of fat in milk.

2. *Casein and albumen.*

a. In several experiments, the amount of casein and albumen in the milk exercised no influence whatever upon the increase of yield, while, in other cases, its influence was small as compared with that of the fat and less, even, than the influence of the water that was retained.

VIII. COMPARISON OF CHEDDAR AND STIRRED-CURD PROCESSES OF MANUFACTURE.

As previously stated, two trials were made to compare the Cheddar and stirred-curd processes. In one comparison, milk containing 3.88 and 3.96 per cent of fat was used; in the other, milk containing 4.70 and 4 73 per cent of fat. We shall compare the two processes with reference to —

1. Amount of fat lost and recovered.
2. Amount of casein and albumen lost and recovered.
3. Composition of cheese as influenced by Cheddar and stirred-curd processes.
4. Yield of cheese.
5. Summary of results.

Amount of Fat Lost and Recovered in Cheddar and Stirred-curd Processes.

KIND OF CHEESE.	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in 100 lbs. of milk.	Pounds of fat recovered in 100 lbs. of milk.	Pounds of fat lost in whey from 100 lbs. of fat in milk.	Pounds of fat recovered in green cheese from 100 lbs. of fat in milk.
Stirred-curd .	3.88	0.277	3.603	7.15	92.85
Cheddar	3.96	0.283	3.677	7.14	92.86
Stirred-curd .	4.70	0.359	4.341	7.64	92.36
Cheddar	4.73	0.331	4.399	6.99	93.01

Statement of results.

1. In the first comparison made between the Cheddar and stirred-curd processes, the actual amount as well as the proportion of fat lost is practically the same in both cases.

2. In the second comparison, the Cheddar process gave considerably less loss. That the difference in favor of the Cheddar process in this case was due to the Cheddar process we can not say; changes due to variation of other conditions in the process of manufacture may have made the difference. Further experiments must be made before we can reach reliable conclusions in regard to the loss of fat in the Cheddar process as compared with the stirred-curd process.

AMOUNT OF CASEIN AND ALBUMEN LOST AND RECOVERED IN CHEDDAR AND STIRRED-CURD PROCESSES.

KIND OF CHEESE.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein and albumen recovered in 100 lbs. of milk.	Pounds of casein and albumen lost in 100 lbs. of milk.	Pounds of casein and albumen lost in whey from 100 lbs. of casein and albumen in milk.	Pounds of casein and albumen recovered in cheese from 100 lbs. of casein and albumen in milk.
Stirred-curd..	3.45	2.52	0.93	27.06	72.94
Cheddar ...	3.81	2.89	0.92	24.18	75.82
Stirred-curd..	3.91	2.86	1.05	26.78	73.22
Cheddar	3.53	2.90	0.63	17.93	82.07

Statement of results.

1. In the first comparison, the actual amount of casein lost was about the same, but the actual amounts present in the milk were quite different, 3.45 and 3.81, and so the actual amount recovered in the cheese was greater in the case of the milk containing the larger amount of casein and albumen. However, if we consider the *proportion* of casein and albumen lost, we see that about three per cent. less was lost in the case of the Cheddar.

2. In the second comparison, the conditions were reversed since the milk used in making the stirred-curd cheese contained the larger amount of casein and albumen. The actual amounts recovered were nearly the same, and the actual amounts lost were quite different, being 1.05 in the stirred-curd process, and 0.63 in the Cheddar. Taking the *proportion* lost, we see that of the amount of casein and albumen in the milk, nine per cent less was lost in the case of the Cheddar process.

3. Though, in both trials of comparison, the proportion of casein and albumen in milk lost was less in the Cheddar process,

it is impossible to say that these differences were not due to variations in the process of manufacture that did not relate directly to differences between the Cheddar and stirred-curd processes.

COMPOSITION OF CHEESE AS INFLUENCED BY CHEDDAR AND STIRRED-CURD PROCESSES.

KIND OF CHEESE.	Pounds of fat in 100 pounds of milk.	Pounds of fat in 100 pounds of cheese.	Pounds of water in 100 pounds of cheese.	Pounds of casein in 100 pounds of cheese.
Stirred-curd	3.88	34.5	34.8	24.9
Cheddar	3.96	30.4	37.8	23.5
Stirred-curd	4.70	35.9	33.4	24.7
Cheddar	4.73	34.5	37.4	22.3

Statement of results.

1. In each case of comparison, the Cheddar process produced a cheese containing less fat than the cheese made by the stirred-curd process.

2. In both cases of comparison the cheese made by the Cheddar process contained more water, per hundred pounds of cheese than that made by the stirred-curd process.

3. In both trials of comparison the cheese made by the Cheddar process contained less casein, per hundred pounds of cheese, than that made by the stirred-curd process.

YIELD OF CHEESE AS INFLUENCED BY THE CHEDDAR AND STIRRED-CURD PROCESS.

KIND OF CHEESE.	Pounds of marketable cheese made from 100 pounds of milk.	Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein and albumen in cheese from 100 pounds of milk.	Pounds of fat in 100 pounds milk.	Pounds of fat in cheese from 100 pounds of milk.	Pounds of water, ash, etc., in cheese from 100 pounds of milk.
Stirred-curd .	10.11	3.45	2.57	3.88	3.56	3.98
Cheddar	11.25	3.81	2.75	3.96	3.56	4.94
Stirred-curd .	11.07	3.91	2.78	4.70	4.04	4.25
Cheddar	12.12	3.53	2.80	4.73	4.33	4.99

Statement of results.

1. An examination of the first trial of comparison shows that the Cheddar process made 1.14 pounds more of cheese from 100 pounds of milk than did the stirred-curd process. This increased yield was made up as follows: (1) 0.18 pounds of casein and albumen and (2) 0.96 pounds of water, ash, etc., there being no change in fat.

2. An examination of the second trial of comparison shows that the Cheddar process made 1.05 pounds more of cheese from 100 pounds of milk than did the stirred-curd process. This increased yield was made up as follows: (1) 0.02 pounds of casein and albumen, (2) 0.29 pounds of fat and (3) 0.74 pounds of water, ash, etc.

3 Other conditions remaining the same, it appears that the Cheddar process will yield a larger amount of cheese than the stirred-curd process, and the increased yield is mainly due to the fact that by the Cheddar process a larger amount of moisture is retained in the cheese.

SUMMARY OF RESULTS RELATING TO COMPARISON OF THE CHEDDAR AND STIRRED-CURD PROCESSES.

1. *Loss of milk-constituents in Cheddar process.*

a. *Fat.* In one case, when the milk contained about four per cent. of fat, the proportion of fat lost was the same in both processes; in the other case, when the milk contained nearly five per cent. of fat, the loss of fat was less in the Cheddar process.

b. *Casein and albumen.* In one case, the loss of casein and albumen was three per cent. less in the Cheddar process than in the stirred-curd process, while, in the other case, the loss by the Cheddar process was seven to nine per cent. less than in the stirred-curd process. The causes of these differences were probably due to variations of conditions not, in any way, related to these processes.

2. *Influence of Cheddar process on composition of cheese.*

a. *Fat.* The cheese made by the Cheddar process contained a larger proportion of water and a correspondingly smaller proportion of fat than the cheese made by the stirred-curd process.

b. *Casein and albumen.* The increase of water retained in the cheese by the Cheddar process caused a corresponding diminution in the proportion of casein and albumen in the cheese.

3. *Influence of Cheddar process on yield of cheese.*

a. In both trials the Cheddar process made a larger amount of marketable cheese, producing one pound more of cheese from 100 pounds of milk than did the stirred-curd process.

IX. COMPARISON OF COMMERCIAL AND HOME-MADE RENNET-EXTRACT.

A single trial was made to compare the results of using commercial rennet-extract (Hansen's) with those obtained by using home-made rennet-extract. A single trial must, of course, be valueless for arriving at definite conclusions, but the results are presented for what they are worth. The results will be presented under the following heads:

1. Amount of fat lost and recovered.
2. Amount of casein and albumen lost and recovered.
3. Composition of cheese.
4. Yield of cheese.
5. Summary of results.

AMOUNT OF FAT LOST AND RECOVERED IN USING COMMERCIAL AND HOME-MADE RENNET-EXTRACT.

KIND OF RENNET-EXTRACT USED.	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in 100 lbs. of milk.	Pounds of fat recovered in 100 lbs. of milk.	Pounds of fat lost in whey from 100 lbs. of fat in milk.	Pounds of fat recovered in green cheese from 100 lbs. of fat in milk.
Commercial..	4.70	0.359	4.341	7.64	92.36
Home-made..	4.80	0.373	4.427	7.77	92.23

Statement of results.

1. The actual amount, as well as the proportion, of fat lost and recovered was practically the same in both cases.

AMOUNT OF CASEIN AND ALBUMEN LOST AND RECOVERED IN USING COMMERCIAL AND HOME-MADE RENNET-EXTRACT.

KIND OF RENNET-EXTRACT USED.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein and albumen recovered in 100 lbs. of milk.	Pounds of casein and albumen lost in 100 lbs. of milk.	Pounds of casein and albumen lost in whey from 100 lbs of casein and albumen in milk.	Pounds of casein and albumen recovered in cheese from 100 lbs. of casein and albumen in milk.
Commercial . .	3.91	2.86	1.05	26.78	73.22
Home-made . .	3.24	2.43	0.81	24.97	75.03

Statement of results.

1. In using the home-made rennet-extract, nearly one-quarter of a pound less of casein and albumen was lost for 100 pounds of milk than in using the commercial extract; but this difference was probably due to variations in other conditions of manufacture rather than to any difference in the action of home-made and commercial extract.

COMPOSITION OF CHEESE AS INFLUENCED BY USE OF COMMERCIAL AND HOME-MADE RENNET-EXTRACT.

KIND OF RENNET-EXTRACT USED.	Pounds of fat in 100 lbs. of cheese.	Pounds of water in 100 lbs. of cheese.	Pounds of casein in 100 lbs of cheese.
Commercial	35.9	33.4	24.7
Home-made	39.0	35.9	22.5

Statement of results.

1. In the cheese made by using commercial rennet-extract, the proportion of fat and water was less, and the proportion of casein was more, than in the case where the home-made extract was used. But it is safe to say that these differences were not connected with the kind of rennet-extract used, but were due to differences in other conditions.

Yield of Cheese as Influenced by the Use of Commercial and Home-made Rennet-extract.

KIND OF RENNET-EXTRACT USED.	Pounds of marketable cheese made from 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein and albumen in cheese from 100 lbs. of milk.	Pounds of fat in 100 lbs. of milk.	Pounds of fat in cheese from 100 lbs. of milk.	Pounds of water, ash, etc., in cheese from 100 lbs. of milk.
Commercial..	11.07	3.91	2.78	4.70	4.04	4.25
Home-made .	11.12	3.24	2.58	4.80	4.47	4.07

Statement of results.

1. The yield of marketable cheese from one hundred pounds of milk was practically the same in both cases, though, as already pointed out, the composition of the cheese varied.

Summary of Results Relating to Comparison of Commercial and Home-made Rennet-extract.

In the two experiments, in which comparison was made, no difference, in any respect, could be noticed that could be attributed to difference in the rennet-extract used.

X. CHANGES TAKING PLACE IN THE RIPENING OF CHEESE.

Chemical Changes of the Ripening Process.

The chemical changes that take place in the process of ripening of cheese are not very well understood in detail. According to Blyth, they are somewhat as follows:

1. There is a continuous loss of water.

2. There is a slow development of carbon dioxide, resulting from the decomposition of casein or fat, or both.

3. The glycerides of the fat decompose, setting free the fatty acids, especially the volatile fatty acids.

4. The nitrogen compounds, chief of which is casein, gradually decompose, the nitrogen taking the form of ammonia. Hence, old cheese has an alkaline reaction, while fresh cheese is acid.

5. The ammonia thus formed unites with the fatty acids that have been set free, and forms ammonium salts of these acids, as

ammonium butyrate, ammonium caproate, etc. Also calcium salts of these acids are formed.

6. The casein, so far as it is not decomposed, slowly passes into a soluble condition.

CAUSE OF CHEMICAL CHANGES IN THE RIPENING OF CHEESE.

The chemical changes that take place when cheese ripens are due to the action of bacteria. These bacteria get into the cheese by way of the milk, and they get into the milk from the air, the bodies of cows, the hands of milkers, and all unclean utensils used in storing the milk — in fact, they may come from anything and everything with which the milk chances to come into contact from the time it leaves the cow's udder up to the time it is put into the cheese-press. The nitrogen-compounds of the cheese, as well as the other constituents, furnish an extremely favorable medium for the development of bacteria, other conditions being favorable. The bacteria in some way cause the casein, the albumen, the fat, and the sugar to undergo certain changes, producing new chemical compounds and these new chemical compounds give to the cheese the characteristic taste due to what we call ripening. If the bacteria act more rapidly or for a longer period of time, these products of bacterial action become greater in quantity and the cheese acquires a stronger flavor.

Different bacteria produce different changes, and even the same kind of bacteria, under different conditions, are believed to produce different changes. Hence in the ripening of cheese, we have different results produced, according as certain kinds of bacteria develop more abundantly. Certain bacteria, whether one particular kind or more we can not yet say positively, produce the flavor which the market demands and which may be said to be the result of the natural ripening process. Either these same bacteria under other conditions or other bacteria under conditions suited best to their development often give rise to products that are offensive and that render the cheese worthless. In the present method of ripening cheese, the process is difficult to control, because we do not, at the outset, know what kinds of bacteria we have to deal with in our cheese. It is not improbable that in the near future we shall greatly modify our methods of cheese-making by sterilizing the milk to start with; that is, by destroying all the bacteria that chance to be in the milk, and then adding, in pure form, those bacteria that have been found to produce the desired effect. This method has already been employed in the ripening of cream for butter-making and the desirable bacteria, in pure form, have already been or soon will be placed upon the market.

In connection with the chemical changes of the ripening of cheese, the following points will be noticed briefly:

1. Total loss of weight in ripening.
2. Influence of ripening on fat.
3. Influence of ripening on casein.
4. Influence of ripening on its acidity.
5. Summary of results.

TOTAL LOSS OF WEIGHT IN THE RIPENING OF CHEESE.

The figures in the first three columns of the table below are based upon the actual weights of the cheese taken at the different intervals mentioned, reckoning from the weight of the green cheese in each case.

TABLE SHOWING LOSS OF CHEESE IN WEIGHT IN ONE, THREE, AND FIVE WEEKS.

NUMBER OF EXPERIMENT.	POUNDS LOST IN WEIGHT FOR 100 POUNDS OF CHEESE.			Pounds of fat in 100 pounds of cheese.	Pounds of water in 100 pounds of cheese.	Thickness of each cheese in inches.
	In one week.	In three weeks.	In five weeks.			
1	2.55	5.19	7.45	23.7	42.0	7.5
2	3.45	6.03	8.42	30.6	37.0	4.5
3	3.54	5.56	7.49	34.5	34.8	5.0
4	2.84	5.92	7.91	30.4	37.8	5.8
5	3.37	5.18	6.58	35.9	33.4	6.0
6	2.75	5.44	7.44	34.5	37.4	6.5
7	2.73	6.98	9.30	39.0	35.9	6.3
8	3.43	6.85	8.87	44.6	32.2	7.0

The different cheeses vary in the amount of loss in weight, for the first five weeks, from 6.58 pounds to 9.30 pounds for each hundred pounds of cheese. This is a somewhat larger proportion of loss than is common in factories. It is probably accounted for by the fact that, during the first two weeks after the cheeses were made, the weather was extremely warm and there was no suitable place for storing the cheese at the time, so that they were not at this time kept at an even temperature. After the first month, the cheeses were placed in a room of fairly uniform temperature and kept at 60° to 65° F. They were turned daily.

The cheeses that contained the largest amount of fat were, in two instances, the ones to lose the most weight, though the loss in most cases does not vary with the fat. The water contained in the cheese also appears to be in no way connected with the loss of weight. The cheese containing the largest proportion of water did not lose most, nor did the one containing least water lose least weight. The thickness of the cheese does not appear to be connected with the loss of weight. The cheeses were of uniform diameter, but varied, as shown in the table, in the thickness. Cheeses of the same thickness lost quite different weights. The loss of weight was not uniform from week to week but shows considerable variation.

INFLUENCE OF THE RIPENING OF CHEESE ON THE FAT.

There are two sources of loss or change in the fat contents of cheese in the process of ripening, (1st) *mechanical*, (2d) *chemical*.

1. In the first stages of ripening it is a familiar sight to see the outside of a cheese covered with fat that has exuded from the cheese, especially if the amount of fat in the cheese is large and if the cheese is stored in a room where the temperature is rather high. This loss of fat is what we may call *mechanical* as distinguished from chemical. Owing to the difficulty, previously mentioned, of securing samples of cheese to represent fairly the composition of the whole cheese, the data furnished by analysis of the cheese are not satisfactory and are of practically no value in this connection. As the figures do not give us any real information in regard to the changes of fat due to mechanical loss, they are not presented here. We can say, in general, that during the first five weeks of ripening, there was a loss of fat, as shown by analysis.

2. The *chemical* changes due to the ripening of cheese are mainly a decomposition of the fats with the formation of free fatty

acids. These changes occur mainly after the earlier stages of ripening. No determinations of the amount of free fatty acids have been made up to date, but they will be made in the future analyses of the cheese.

INFLUENCE OF THE RIPENING OF CHEESE ON CASEIN.

The casein in cheese undergoes various changes, forming, among other products, ammonia and soluble nitrogen compounds, which are probably peptones.

About thirty years ago, Blondeau, a French chemist, and some others claimed that, in the ripening of cheese, the casein slowly changed into fat. Müller, Sieber and Brassier have, however, shown that such a change does not take place. It is not uncommon, even in some of our standard authorities on physiology to-day, to see the erroneous conclusions of Blondeau referred to as undisputed facts.

The nitrogen determinations made in the cheese under experiment were, for the first five weeks, (1st) the total casein, etc., and (2d) the proportion of nitrogen compounds soluble in water. In these determinations, the same difficulty of sampling was found, as already mentioned. In some cases, the different samples appeared to show an increase of casein, which could be accounted for only on the ground of a real difference in the samples analyzed. In some cases, there was little change from week to week, while in others, there was a decrease in the amount of casein.

The soluble portion was determined by agitating about two grams of cheese with cold water, in the proportion of 100 parts of water to one cheese. The insoluble portion was filtered off, washed, and then digested by the Kjeldahl method for nitrogen determination. The soluble portion was thus determined by difference. While the results are not entirely concordant, they are of considerable interest in this connection. In the table below we present the data in two forms, giving first, the actual number of pounds of soluble nitrogen compounds in 100 pounds of cheese; and, second, the proportion of the total nitrogen compounds that were soluble in water.

NUMBER OF EXPERIMENT.	POUNDS OF SOLUBLE NITROGEN COMPOUNDS IN 100 POUNDS OF CHEESE.				POUNDS OF SOLUBLE NITROGEN COMPOUNDS IN 100 POUNDS OF TOTAL CASEIN, ETC.			
	In green cheese.	In cheese at seven days.	In cheese at twenty-one days.	In cheese at thirty-five days.	In green cheese.	In cheese at seven days.	In cheese at twenty-one days.	In cheese at thirty-five days.
1	....	4.85	4.16	5.67	....	17.6	15.5	19.7
2	....	2.97	2.78	5.64	....	12.8	11.4	20.1
3	....	6.51	5.39	6.02	....	26.7	21.8	23.5
4	1.57	0.89	5.38	5.70	6.9	3.9	22.1	24.0
5	....	3.93	5.65	4.12	....	16.2	22.8	16.5
6	1.14	1.90	4.56	4.11	5.8	8.8	19.3	19.5
7	....	....	5.77	7.06	....	....	25.6	30.0
8	....	1.19	5.57	6.48	....	6.9	31.7	35.1

We notice the following points of interest:

1. In the fourth and sixth experiments, in which the cheese was analyzed as soon as taken from the press, we see that the amount of nitrogen compounds soluble in water is 1.57 and 1.14 per cent of the cheese. This, doubtless, represents the amount of albumen of the milk which was retained mechanically in the cheese. This constitutes six or seven per cent of the nitrogen compounds (the casein and albumen together) in the green cheese.

2. There appears to be a general tendency in the soluble nitrogen compounds to increase in quantity as the cheese becomes older.

3. If we examine the last two columns in the above table we can see that there appears to be a tendency for the nitrogen compounds to become soluble more rapidly in those cheeses that contain the largest amount of fat. Leaving out the fifth and sixth experiments, the tendency appears to be quite marked. In the first cheese the fat was least; in the seventh and eighth, most; in the first cheese the proportion of soluble nitrogen compounds is least, while in the eighth case it is most; and intermediate in the other cases.

If future work should prove that this is a general tendency in the ripening of cheese, it would have a very important bearing upon the question of skim-cheese and rich cheese. The more rapidly the insoluble casein becomes soluble, the more easily digestible does the cheese become; and if the above tendency is found to hold good in all cases, then it would follow that skim-cheese becomes digestible less rapidly than rich cheese, so far as the nitrogen compounds are concerned.

In our future work on the ripening process, we shall endeavor to make a more detailed study of the character of nitrogen compounds formed in the different stages of ripening.

INFLUENCE OF RIPENING OF CHEESE UPON ITS ACIDITY.

The acids formed in the process of cheese-making, chief of which is lactic acid, are retained, mechanically, to some extent in the cheese.

The method of determining the acidity of the cheese was to agitate a few grams of cheese with water for several minutes, then to filter and titrate the filtrate with standardized sodium hydroxide solution. The results were calculated for lactic acid.

In the table below is given the per cent. of acid in the first and second wheys and in the cheese at different ages:

NUMBER OF EXPERIMENT.	POUNDS OF LACTIC ACID IN 100 POUNDS.		POUNDS OF LACTIC ACID IN 100 POUNDS OF CHEESE.			
	Of the first whey.	Of the second whey.	In green cheese.	In cheese at seven days.	In cheese at twenty-one days.	In cheese at thirty-five days.
1	0.18	.....	....	1.17	1.06	0.76
2	0.17	0.26	....	0.69	0.79	0.65
3	0.16	0.26	....	1.27	0.92	0.72
4	0.17	0.24	0.58	0.46	0.42	0.53
5	0.21	0.30	...	0.64	0.73	0.54
6	0.16	0.25	0.62	0.52	0.56	0.54
7	0.25	0.39	...	0.70	0.65	0.62
8	0.20	0.29	....	0.58	0.72	0.51

1. It does not appear from the above table that the amount of acidity in the cheese corresponds with the amount of acidity in the whey of the same cheese. If the treatment were exactly the same in every respect, we should expect to get a more acid cheese in the case where the whey is more acid, and we doubtless should;

but, with differences in treatment, we should not expect to get cheese with the same amount of acidity. In the fourth and sixth experiments, where the Cheddar process was used, the acidity of the cheese was least of all, and considerably less than in the second and third experiments, where the acidity of the wheys was about the same.

2. There is a general tendency, strongly marked, to decreased acidity as the cheese becomes older.

The decreased acidity is probably an indication of the extent of decomposition of casein; the ammonia formed from the casein unites with the free acid and thus diminishes the acidity. Whether, in any case, the conversion of sugar into lactic acid continues to take place in the cheese, we can not say.

CONTINUATION OF THE STUDY OF THE RIPENING OF CHEESE.

The cheeses under experiment will be preserved, and the study of the ripening process will be continued until the cheeses are, at least, a year old. An effort will be made to make the future analyses more detailed, especially as regards the changes in the fatty compounds and the nitrogen compounds.

SUMMARY OF RESULTS RELATING TO THE CHANGES THAT TAKE PLACE IN THE RIPENING OF CHEESE.

1. *Total loss of weight in ripening.*

a. The loss of weight varied, for the first five weeks, from 6.58 pounds to 9.30 pounds for each hundred pounds of cheese.

2. *Changes of fat due to ripening.*

a. There was a mechanical loss of fat, the exact amount of which was difficult to determine.

3. *Changes of casein due to ripening.*

a. There was practically no appreciable loss of casein during the first five weeks.

b. Analysis of two green cheeses indicated between one and two per cent of albumen in the cheese.

c. There appeared to be a general tendency for the insoluble casein to become less in quantity and for the soluble nitrogen compounds to increase.

d. The soluble nitrogen compounds showed a tendency to increase more rapidly in the cheeses containing the larger amounts of fat.

4. *Changes of acidity due to ripening.*

a. The acidity showed a marked tendency to diminish as the cheese became older.

XI. LINES OF WORK IN FUTURE INVESTIGATIONS OF CHEESE.

The present investigation has proved fruitful in furnishing suggestions for future lines of work. Among the points which it is desirable to investigate more fully, we may mention the following:

1. The *maximum loss of fat* that can be regarded as unavoidable in the manufacture of cheese from normal milk containing different amounts of fat.

2. Whether, under the same conditions of manufacture, there is a *definite relation between the amount of fat in the milk and the proportion of fat in the corresponding cheese;* if there is such a definite relation, what is it?

3. The *cheese-making power or efficiency* of fat in milk for normal milk containing different amounts of fat; that is, the relation of fat in milk to yield of cheese. For example, how much cheese should milk containing three per cent of fat, three and one-half per cent, four per cent, etc., produce?

4. The conditions under which, and the extent to which, casein is lost in cheese-making, and in what manner such loss can be controlled.

5. The relation of casein to albumen in milk.

6. The definite relation, if any exists, between the amount of casein in milk and the proportion of casein in the corresponding cheese.

7. The cheese-making power or efficiency of casein and albumen in milk.

8. In what manner albumen can be incorporated into cheese and a good commercial article produced.

9. In what manner and to what extent, if at all, rennet affects the ripening of cheese.

10. An extended comparison of the stirred-curd and Cheddar processes of manufacture with reference to (1st) the loss of milk constituents, (2d) the composition of the cheese, and (3d) the yield of cheese.

11. What changes occur in the ripening process (*a*) in the composition of the fat, (*b*) in the composition of the casein and albumen, and (*c*) in the sugar.

XII. RESULTS OF INVESTIGATION OF CHEESE APPLIED TO PRACTICAL DAIRY PROBLEMS.

Under this head, we shall treat, in a more or less general way, the following subjects:

1. The common method of paying for milk at cheese factories.
2. The method of paying for milk according to the amount of fat contained in it.
3. Manufacture of whole-milk cheese and skim-milk cheese.
4. Remedy for the chief defect in the present method of judging cheese in open market.
5. Cheese-making and butter-making.

THE COMMON METHOD OF PAYING FOR MILK AT CHEESE FACTORIES.

We will suppose that eight men take milk to a cheese factory, each man furnishing 100 pounds of milk varying in composition according to the milk used in the series of experiments described in this report; that is, the first man's milk is like that used in the first experiment, the second one's like that used in the second experiment, etc. We will suppose that these milks, mixed together, make the same amount of cheese as when they are separate, though, as a matter of fact, they would probably produce a little more cheese when mixed. As seen in the table below, the amount of marketable cheese made from these milks, 100 pounds of each, is 86.1 pounds. Suppose the cheese sells for 9.85 cents per pound; that is equivalent to twenty-five cents for each pound of fat in the milk; the present market price of cheese would probably justify a higher price. The amount of money received for the 86.1 pounds of cheese at 9.85 cents per pound would be eight dollars and forty-eight cents. There are eight men to share it equally, as each contributed the same amount of milk; hence the share of each would be about one dollar and six cents.

THE METHOD OF PAYING FOR MILK AT CHEESE-FACTORIES ACCORDING TO THE AMOUNT OF FAT IN THE MILK.

First method. We will suppose that the same amount of milk is contributed by each man and that the same amount of cheese is made as in the foregoing instance. We will suppose, as before, that the cheese sells for 9.85 cents per pound, giving as total for the whole amount of cheese eight dollars and forty-eight cents. The entire amount of fat in all the milk is 33.92 pounds. That would make each pound of fat in the milk worth twenty-five cents per pound. Then, by multiplying the pounds of fat contained in the milk contributed by each man, we obtain the amount of money due each, which is shown in the table below.

Second method. Another way would be to find how much cheese one pound of fat in the milk will make. The milks, mixed together make 86.1 pounds of cheese from 33.92 pounds of fat. By dividing the amount of cheese by the amount of fat in the milk, we get the amount of cheese which one pound of fat in the milk actually makes; in this case, there are 2.54 pounds of cheese for each pound of fat in the milk. Now, if we multiply the amount of fat in each milk by 2.54, we find how much cheese it made. This amount of cheese, multiplied by the selling price per pound, will give the same numbers as those obtained by the preceding method.

TABLE ILLUSTRATING METHODS OF PAYING FOR MILK AT CHEESE FACTORIES.

NUMBER OF EXPERIMENT.	Pounds of marketable cheese from 100 lbs. of milk.	Pounds of fat in 100 lbs. of milk.	Value of 100 lbs. of milk paid for by common methods.*	Value of 100 lbs. of milk paid for according to amount of fat in milk.*
1	9.05	2.35	$1 06	$0 59
2	8.86	3.01	1 06	0 75
3	10.11	3.88	1 06	0 97
4	11.25	3.96	1 06	0 99
5	11.07	4.70	1 06	1 17
6	12.12	4.73	1 06	1 18
7	11.12	4.80	1 06	1 20
8	12.52	6.49	1 06	1 62

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* Calculated on the basis of fat in milk at twenty-five cents per pound, or cheese at an average of 9.85 cents per pound.

In an ordinary cheese factory, the difference in the amount of fat in the milk would, of course, be very much less. Most factory milks in this State probably average between three and four per cent. in fat. It is probable that in actual cheese-factory practice the best milk, paid for on the basis of its fat, would bring about twenty-five cents more per hundred than the milk containing the least fat.

MANUFACTURE OF WHOLE-MILK CHEESE AND SKIM-MILK CHEESE.

Which pays better, the manufacture of skim-milk cheese and butter or the manufacture of whole-milk cheese? This question is far from being a new one, but it may be of interest to try to answer the question in connection with these experiments. While our data are not extended enough to be of practical use in this connection, they may serve as a guide for general discussion. Among the points that must be considered in discussing this question are the following: (1st) Does milk, poor in fat, make more or less cheese in proportion to its per cent of fat than milk richer in fat? (2d) Does cheese made from milk, poor in fat, sell for a greater or less price in proportion to the fat in the milk than cheese made from milk richer in fat? (3d) Do the butter and the skim-cheese made from the same milk bring, together, a larger price than would the cheese made from the same milk unskimmed? (4th) What is likely to be the ultimate effect of manufacturing skim-cheese upon the consumption of cheese?

1. POUNDS OF CHEESE MADE FOR EACH POUND OF FAT IN THE MILK.

	NUMBER OF EXPERIMENT.							
	1	2	3	4	5	6	7	8
Pounds of cheese for one pound of fat in the milk.	3.85	2.94	2.60	2.84	2.35	2.56	2.32	1.93
Pounds of fat in 100 pounds of milk..................	2.35	3.01	3.88	3.96	4.70	4.73	4.80	6.49

An examination of these figures indicates that *a pound of fat in a milk, poor in fat, will, as a rule, make more cheese than will a pound of fat in richer milk.* This would be expected, because the poorer milk contains larger proportions of casein relative to the fat than the richer ones, and, moreover, cheese, rich in casein, tends to take up more water than cheese rich in fat, conditions of manufacture being the same. Hence, cheese made from skim-milk contains casein and water in large proportions and fat in relatively small proportions. This would, of course, affect the quality of the cheese. This point would bring us to the second question.

2. *Does cheese made from milk, poor in fat, sell for a greater or less price in proportion to the fat in the milk than cheese made from milk richer in fat?* In the arrangement given below, are indicated the prices per pound each cheese would have to sell for in order to realize twenty-five cents per pound for each pound of fat in milk. These figures are based upon the amount of cheese made from each milk separately.

	NUMBER OF EXPERIMENT.							
	1	2	3	4	5	6	7	8
Pounds of marketable cheese from 100 lbs. of milk	9.05	8.86	10.11	11.25	11.07	12.12	11.12	12.52
Pounds of fat in 100 lbs. of milk	2.35	3.01	3.88	3.96	4.70	4.73	4.80	6.49
Price in cents per pound of cheese, on basis of milk-fat at 25 cents per pound	6.50	8.50	9.60	8.80	10.60	9.80	10.80	13.00

It is probable that the first cheese would sell, in the open market, for a little more than 6.5 cents and for a little less than the second cheese; while the others would probably sell for ten or eleven cents at present prices. This, of course, presupposes that the cheeses are all equally well made. The eighth cheese would not be likely to bring thirteen cents in open market, though it would doubtless bring more than this in some special market. While we can not say definitely what each cheese would sell for in the open market, it is probable that the first cheese and, perhaps, the second cheese would realize more than twenty-five cents a pound for each pound of milk-fat; that the other cheeses would sell for nearly a uniform price, so that cheese made from milk containing over four per cent of fat would not realize over twenty-five cents per pound for the milk-fat and might fall short of this. To settle this point definitely these cheeses should have been sent to one or more market points to be examined by experts, when of marketable age, but it was not feasible, as the cheeses were to be used for study of the ripening process.

Perhaps the most that we can be warranted in saying is that it would probably not pay to work up into cheese, for the general market, milk containing much over four per cent. of fat. There are, probably, very few cheese factories in the State that are in any serious danger of getting milk that averages over four per cent. of fat for the season.

3. *Does the manufacture of cheese from ordinary factory milk pay better than the manufacture of skim-cheese and butter?* Much the same question is involved as in the preceding instance. To answer the question, we need to know (1st) how much butter and skim-cheese can be made from a certain quantity of milk; (2d) how much cheese can be made from the same quantity of the same milk; and (3d) what would be the market value of these products in each case.

In the case of a milk containing five per cent. or more of fat, doubtless one-fifth of the fat could be removed, made into butter and the remaining milk made into cheese that would sell per pound in open market for as much as the cheese made from the whole milk. If the price of butter were not very low compared with the price of cheese, the value of the fat in the butter would be greater than if made into cheese, since the cheese-making power of a pound of milk-fat tends to diminish quite rapidly when the amount of fat goes beyond that of average milk, and, in addition, the open market would, probably, in most cases recognize no difference between cheese made from milk containing four per cent. of fat and that containing five per cent.

To discuss the question in a more specific manner, we will take an illustration based on these experiments.

Suppose average factory milk contains about 3.5 pounds of fat in 100 pounds of milk. If made into cheese, each pound of fat would make, on an average, about 2.75 pounds of cheese, and 100 pounds of milk would make about 9.6 pounds of cheese. To realize twenty-five cents per pound for milk-fat, this cheese would have to sell for about 9.1 cents per pound.

Suppose, now, one pound of fat is removed from the milk and made into butter. Then, from each hundred pounds of milk we should make about 1.1 pounds of butter and not more than 7.5 pounds of cheese, since taking out one pound of fat from such milk would reduce the cheese-making power of the remaining milk not less than two pounds, and might considerably more. To realize twenty-five cents for each pound of milk-fat, the butter and cheese would have to sell for 87.4 cents; or the butter would have to sell for 22.7 cents per pound and the cheese for 8.6 cents per pound, and it is safe to presume that the cheese would not sell for any such price if the whole-milk cheese sells for 9.1 cents per pound, but that the butter and cheese together would sell for considerably less than the whole-milk cheese. The additional fat in the whole-milk cheese adds to the quality of the cheese more than enough to compensate for the diminished comparative yield.

In making the above estimates, the error, if any, has been made in favor of the skim-cheese.

It is, therefore, probably true that, under usual conditions, ordinary cheese-factory milk will yield a larger money return if made into cheese than if made into butter and skim-cheese. To demonstrate the point beyond all doubt, we need more extensive data.

4. *The ultimate effect of the manufacture of skim-cheese upon the general consumption of cheese.* Here we venture somewhat into the realm of the speculative. But, granting that more money can be gotten out of milk when made into butter and skim-milk cheese than when made into whole-milk cheese, does the manufacture of skim-milk cheese increase the aggregate consumption of cheese? There may be exceptional cases where persons prefer skim-milk cheese, but it is probably true that most people would prefer whole-milk cheese if they were taught to know the difference once. The entire annihilation of the manufacture of skim-cheese and the simultaneous improvement of the manufacture of whole-milk cheese would have a tendency to increase the aggregate consumption of cheese and make better prices. If skim-milk cheese must be made, it should go into the market branded as such in order that those who prefer skim-cheese may not run any risk of getting what they do not want; and likewise those who do not want skim-milk cheese. The invariable effect of putting poor, cheap products upon the market is to discourage ultimately the production of the better grades of the same kind of products. Improvement of quality in any product is followed by increased demand at relatively better prices.

REMEDY FOR THE CHIEF DEFECT IN THE PRESENT METHOD OF JUDGING CHEESE IN OPEN MARKET.

If the experiments described in this report suggest anything at all, they indicate that the fat in the milk is the most potent factor in determining the yield and quality of cheese, and that the quality of cheese is largely affected by the amount of fat contained in it. In the present method of judging cheese, only such general qualities, not always any too definite, as texture, flavor, etc., are used in determining the value of a cheese. How widely two experts may differ is well known. The factor of greatest importance — the amount of fat in cheese — is completely ignored. *We can not expect to receive pay for cheese according to its value until the amount of fat is taken into consideration in addition to the other points.* The desirability of considering this point in judging cheese is too evident to need any discussion.

CHEESE-MAKING AND BUTTER-MAKING.

Which pays better, to make milk into butter or cheese? The answer depends upon various conditions, such as (1st) the relative prices of cheese and butter, (2d) the amount of loss in the two kinds of manufacture, the amount and quality of the manufactured product, etc.

1. In winter, butter-making pays better, since the amount of fresh butter is far below the demand, and prices are comparatively high. In summer, cheese-making pays better, since the price of butter is then lowest, and, in the form of cheese, the product can be held and stored until prices are high.

2. As regards the loss of fat in cheese-making and butter-making, we may put the average cheese-factory loss of fat at not less than seven pounds of fat for each hundred pounds of milk-fat; this may not be high enough, as we have few data to base the opinion on. This would be equivalent to a loss of one pound of fat for a little over 400 pounds of milk or about one-quarter of a pound of fat for 100 pounds of milk. In the case of butter-making from the same milk, by ordinary processes of creaming by gravity-setting, of churning, etc., as in the case of the average farmer, the loss would be not far from half a pound of fat for every hundred pounds of milk. By using a centrifugal machine for separating the cream, and by skillful handling in subsequent

operations, the loss of fat can be reduced to less than six pounds of fat for each hundred pounds of milk-fat, which would, in case of milk containing 3.5 per cent. of fat, be equivalent to a loss of one pound of fat for 500 pounds of milk or one-fifth of a pound of fat for 100 pounds of milk.

As to yield of cheese and butter, the average yield of cheese on the above supposition would be about ten pounds of cheese for 100 pounds of milk. In the case of butter, as made by the average farmer, the amount of butter made from 100 pounds of milk would be about 3.5 pounds. In the best creameries, the yield would not be less than 3.9 pounds per hundred pounds of milk.

To realize twenty-five cents a pound on each pound of milk-fat, the cheese would have to sell at 8.75 cents per pound; the butter for 25 to 22.5, according to the amount lost in making.

XIII. GENERAL SUMMARY OF RESULTS OF INVESTIGATION OF CHEESE.

LOSS OF MILK CONSTITUENTS IN CHEESE-MAKING.

1. *Fat.*

a. The actual amount, as well as the proportion, of milk-fat lost in the whey increased gradually, but not uniformly, when the amount of fat in the milk increased.

b. The average amount of fat lost in the whey in all the experiments was about one-third of a pound for 100 pounds of milk, which was about 7.5 per cent. of the milk-fat. Taking only those experiments which most nearly represented average factory milk, the average amount of milk-fat lost was one-quarter of a pound for 100 pounds of milk, which was nearly seven per cent. of the milk-fat.

c. While it was true that the loss of fat increased, both absolutely and relatively, when the amount of fat in the milk increased, it was not true that all the additional fat above four per cent. or even above five and one-half per cent. was lost in the whey.

2. *Casein and albumen.*

a. The amount of casein and albumen lost appeared to bear no definite relation to the total amount of casein and albumen in the milk.

b. The average amount of casein and albumen in the milk in the eight experiments was 3.43 pounds per hundred pounds of milk; of this amount, about twenty-three per cent., or about 0.8 pounds, were lost.

c. The irregular variations in the proportion of casein and albumen lost were probably due to variations in the conditions of manufacture.

3. *Loss of fat and of casein and albumen in cheese-making as influenced by proportion of fat to casein and albumen in milk.*

a. When the amount of casein and albumen in the milk was nearly the same as, or greater than, the amount of fat, the loss of fat was least. When the amount of fat became considerably greater than the amount of casein and albumen, then the loss of fat increased. Comparatively large proportions of casein served to hold the fat more completely in the curd, as would be expected.

b. The amount of fat in the milk appeared, in no way, to have any influence on the amount of casein and albumen lost in the process of manufacture.

INFLUENCE OF COMPOSITION OF MILK ON COMPOSITION OF CHEESE.

1. *Fat.*

a. The proportion of fat in the cheese showed a tendency to increase, but not uniformly, when the amount of fat in the milk increased. There were about 24 pounds of fat in 100 pounds of cheese made from the skim-milk, while 100 pounds of the cheese made from the milk richest in fat contained about 45 pounds of fat.

b. Under the conditions of manufacture employed, cheese containing 30 pounds of fat per hundred pounds of cheese could not be made from milk containing less than three per cent of fat.

c. The fat exercised a greater influence on the composition of the cheese than any other constituent of the milk.

2. *Casein and albumen.*

a. There appeared to be no relation between the amount of casein and albumen in the milk and the amount of casein and albumen in 100 pounds of cheese.

3. *Composition of cheese as influenced by the proportion of fat to casein and albumen in milk.*

a. When the casein and albumen were present in the milk in largest quantities relative to the fat, the proportion of casein was greatest in the cheese; and when the fat in the milk was greatest relative to the casein and albumen, the casein in the cheese was least.

INFLUENCE OF COMPOSITION OF MILK ON YIELD OF CHEESE.

1. *Fat.*

a. The yield of cheese increased when the amount of fat in the milk increased, but not uniformly so.

b. In three experiments the increased yield of cheese was *wholly* due to increase of fat in the milk; while, in the other experiments, the increased yield was *mainly* due to increase of fat in milk.

2. *Casein and albumen.*

a. In several experiments, the amount of casein and albumen in the milk exercised no influence whatever upon the increase of yield, while, in the other cases, its influence was small as compared with that of the fat and less, even, than the influence of the water that was retained.

COMPARISON OF CHEDDAR AND STIRRED-CURD PROCESSES.

1. *Loss of milk-constituents in Cheddar process.*

a. Fat.—In one case, when the milk contained about four per cent. of fat, the proportion of fat lost was the same in both processes; in the other case, when the milk contained nearly five per cent. of fat, the loss of fat was less in the Cheddar process.

b. Casein and albumen.—In one case, the loss of casein and albumen was three per cent. less in the Cheddar process than in the stirred-curd process; while, in the other case, the loss by the Cheddar process was seven to nine per cent. less than in the stirred-curd process. The causes of these differences were probably due to variations of conditions not, in any way, related to these processes.

2. *Influence of Cheddar process on composition of cheese.*

a. Fat.—The cheese made by the Cheddar process contained a larger proportion of water and a correspondingly smaller proportion of fat than the cheese made by the stirred-curd process.

b. Casein and albumen.—The increase of water retained in the cheese by the Cheddar process caused a corresponding diminution in the proportion of casein and albumen in the cheese.

3. *Influence of Cheddar process on yield of cheese.*

a. In both trials, the Cheddar process made a larger amount of marketable cheese, producing one pound more of cheese from 100 pounds of milk than did the stirred-curd process.

COMPARISON OF COMMERCIAL AND HOME-MADE RENNET-EXTRACT.

In the two experiments, in which comparisons were made, no difference, in any respect, could be noticed that could be attributed to difference in the rennet-extract used.

CHANGES TAKING PLACE IN THE RIPENING OF CHEESE.

1. *Total loss of weight in ripening.*

a. The loss of weight varied, for the first five weeks, from 6.58 pounds to 9.30 pounds for each hundred pounds of cheese.

2. *Changes of fat due to ripening.*

a. There was a mechanical loss of fat, the exact amount of which was difficult to determine.

3. *Changes of casein due to ripening.*

a. There was practically no appreciable loss of casein during the first five weeks.

b. Analysis of two green cheeses indicated between one and two per cent of albumen in the cheese.

c. There appeared to be a general tendency for the insoluble casein to become less in quantity and for the soluble nitrogen compounds to increase.

d. The soluble nitrogen compounds showed a tendency to increase more rapidly in the cheeses containing the larger amounts of fat.

4. *Changes of acidity due to ripening.*

a. The acidity showed a marked tendency to diminish as the cheese became older.

SOME PRACTICAL APPLICATIONS.

1. *Milk-fat as a basis for purchasing milk at cheese factories.*

a. The method of paying for milk at cheese factories according to the amount of milk delivered, regardless of its composition, is unjust to the producers of the better milk. Payment for milk on the basis of the fat contained in it is the best method yet proposed, mainly for three reasons, (1st) the milk-fat appears to exercise a greater influence upon the composition and yield of cheese than does any other constituent of milk, and, therefore, forms a just basis for estimating the cheese-producing efficiency of factory milk; (2d) payment for milk according to its fat encourages and induces dairymen to produce a better quality of milk; (3d) payment for fat in milk removes any temptation to adulterate milk.

2. *Skimming factory milk.*

a. Taking the average factory milk of this State, it is probable that it is none too good for cheese-making and that removal of cream diminishes both the yield and quality of the cheese.

b. It seems probable that, under ordinary circumstances, a better money-return can be expected from average factory milk when made into whole-milk cheese than when skimmed partially and made into butter and skim-milk cheese.

XIV. COMPARISON OF DAIRY BREEDS OF CATTLE WITH REFERENCE TO PRODUCTION OF BUTTER.

It is the purpose of this report to present and discuss briefly the data that have accumulated up to December 1, 1891, in connection with the making of butter from the milk of the various individuals of breeds undergoing experiment. This will enable us to present the records of one or more individuals of each of six breeds for the first period of lactation. We are not yet able to give the complete record of four or more individuals of each breed for the first period of lactation, as we shall be able to do later. Special caution must be given, therefore, in regard to drawing any general conclusions from the results presented; for, until we have complete results from all the individuals of each breed, we can not establish any conclusions that may be regarded as definite and reliable. However, it will be seen that very much interest attaches to the results thus far obtained.

In order that those who are not acquainted with the previous history of this investigation may have a complete understanding of the character and objects of the work, they are referred to the following Station publications for the plans proposed and the results already secured:

(1.) Eighth annual report of director (1889), pp. 14-21.

(2.) Eighth annual report of chemist (1889), pp. 153-203.

(3.) Bulletin No. 18, new series, November, 1889, on "Testing of Dairy Breeds."

(4.) Bulletin No. 20, new series, June, 1890, on "Pedigrees of Animals under Investigation."

(5.) Ninth annual report of chemist (1890), pp. 173-242.

(6.) Ninth annual report of farm superintendent (1890), pp. 400-444.

(7.) Bulletin No. 34, new series, August, 1891, on "Comparison of Dairy Breeds of Cattle with Reference to Production of Butter."

For a full description of the chemical work connected with this investigation, and for a full statement of the methods employed in creaming, churning, etc., the reader is referred to the chemist's report for 1890, pp. 197-206.

LENGTH OF LACTATION PERIOD.

The unit of time adopted for the purpose of comparing the breeds in regard to their production of milk, butter and cheese is the first ten months of each period of lactation. While the period of ten months is probably considerably longer than the average lactation period of the cows of the average dairyman, the present tendency in the best dairy practice is to utilize the cow as long as possible, and with our best dairymen, the lactation period is probably made to equal or exceed ten months in duration.

NUMBER OF INDIVIDUALS OF EACH BREED USED FOR COMPARISON IN THIS REPORT.

In the tables which contain the monthly averages of the different breeds, the number of individuals of each breed is indicated below:

MONTH OF LACTATION.	Number of Ayrshires.	Number of Devons.	Number of Guernseys.	Number of Holderness.	Number of Holsteins.	Number of Jerseys.
1........	2	2	2	2	....	1
2........	3	2	2	2	1	2
3........	3	2	2	2	1	2
4	3	2	2	2	1	2
5.......	3	2	2	2	1	3
6........	3	2	2	2	1	3
7........	4	1	2	2	1	3
8........	4	1	2	2	1	3
9........	4	1	2	2	1	3
10........	4	1	2	2	1	3

Owing to unavoidable difficulties connected with the organization of the investigation, it is probable that the results obtained from the second period of lactation will afford a more complete and satisfactory basis of comparison in all cases.

METHODS EMPLOYED IN CALCULATING AVERAGES OF MONTHLY YIELDS.

The months of lactation are made to coincide with the calendar months, since the records are all kept and the changes of rations made by calendar months. It, therefore, happens in most cases that the first month of lactation is less than a full calendar month In calculating the monthly averages, for obtaining monthly yields of milk, cream, butter, etc., the first month, if incomplete, is calculated up to a full month.

OUTLINE OF DATA TO BE PRESENTED.

The data will be presented and considered under the following heads:

1. Cost of food consumed and of butter produced.
2. Fat lost and recovered in butter-making: (1) Fat in milk; (2) Fat in skim-milk; (3) Fat in cream; (4) Fat in butter-milk; (5) Fat in butter; (6) Yield of butter; (7) Butter-making efficiency of milk-fat; (8) Summary of results.

3. Relations of milk, cream and butter: (1) Pounds of milk required to make one pound of butter; (2) Pounds of milk required to make one pound of cream; (3) Pounds of cream required to make one pound of butter; (4) Per cent. of fat in cream; (5) Summary of results.
4. Daily yields milk and butter.
5. Monthly yields of dairy products: (1) Pounds of milk; (2) Pounds of skim-milk; (3) Pounds of cream; (4) Pounds of butter-milk; (5) Pounds of fat in milk; (6) Pounds of fat in butter; (7) Pounds of butter; (8) Summary of results.
6. Temperature and time of churning.
7. Fat globules of milk: (1) Relative number of fat globules; (2) Relative size of fat globules.

COST OF FOOD CONSUMED AND OF BUTTER PRODUCED.

The composition of the foods and of the various rations given the cows under investigation, are fully given in the director's report. The values assigned to the food materials are the regular market value at the time they were purchased and fed, and are as follows:

Clover hay	$12 00
Mixed-grass hay	10 00
Ensilage	3 00
Forage	2 00
Mangolds	3 00
Corn meal	20 00
Wheat bran	20 00
Ground oats	25 00
Linseed meal (old process)	26 50
Linseed meal (new process)	20 00
Gluten meal	27 00
Wheat middlings	20 00
Cotton-seed meal	29 60

It will be noticed that many of the foods were above their average market price.

TABLE SHOWING COST OF FOOD CONSUMED.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	$1 31	$1 20	$1 55	$0 63	......	$1 13
2	3 60	2 83	3 23	3 72	$5 24	4 11
3	4 17	3 41	4 04	4 65	5 67	5 19
4	4 84	3 32	4 33	4 00	5 83	4 71
5	5 22	3 33	4 48	3 93	5 06	4 85
6	4 54	3 45	4 66	3 50	5 81	4 76
7	4 67	3 70	4 35	3 69	5 73	4 51
8	4 39	3 20	4 21	3 50	5 12	4 59
9	4 61	4 31	3 66	3 59	5 09	4 41
10	4 92	4 33	4 08	2 46	5 48	4 35

Monthly average for the first period of lactation:

(1.) Devons	$3 37
(2.) Holderness	3 46
(3.) Guernseys	3 94
(4.) Ayrshires	4 33
(5.) Jerseys	4 46
(6.) Holsteins	5 45

The table given below, which shows the cost, in cents, of the food consumed for each pound of butter made, is based upon the figures given in the table above and those in a table presented later, which gives the average number of pounds of butter made for each month of lactation.

TABLE SHOWING COST (IN CENTS) OF FOOD CONSUMED FOR EACH POUND OF BUTTER MADE.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1..........	14.24	15.00	9.57	8.63	......	9.96
2..........	16.14	17.69	11.79	20.00	21.65	14.73
3..........	22.18	20.42	15.42	25.69	19.55	19.96
4..........	23.38	20.00	16.59	23.81	26.74	17.64
5..........	26.77	23.61	15.45	24.56	23.87	16.61
6..........	24.41	23.31	16.94	24.65	21.05	18.74
7..........	26.84	29.83	16.41	24.93	21.22	18.18
8..........	28.50	23.20	15.36	26.00	21.60	18.36
9..........	27.00	24.08	13.66	25.30	20.36	17.85
10..........	27.43	25.17	17.21	19.83	33.00	17.75

Monthly averages for the first period of lactation:

(1.) Guernseys	14.70
(2.) Jerseys	16.70
(3.) Holderness	22.04
(4.) Devons	22.17
(5.) Holsteins	22.61
(6.) Ayrshires	23.03

In calculating the cost of butter production in the foregoing table, the food alone is considered. The skim-milk and buttermilk are worth something, but there is no recognized market value for these by-products, and it is considered best to leave them out of consideration, and to calculate the cost of the butter without reference to them.

For the sake of uniformity in making our comparisons of the breeds, we have arbitrarily adopted ten months as the duration of a single period of lactation. In actual dairying, if a cow were productive ten months in each year, and non-productive during two months, the cost of keeping her twelve months would need to be considered in order to find the actual cost of butter produced. The actual cost of her production would be based, not upon the cost of her food for the ten productive months, but upon the cost of her food for the whole year, the non-productive as well as the productive period. However, in this investigation, we are not so much concerned with actual cost as with relative cost of butter production. Therefore, calculating for all breeds alike, the cost of butter production from the food consumed during the same productive period, we secure values that show the true *relative* cost of production for the different breeds.

Below, we present the profits given by each breed from the butter production of the first period of lactation, cost of food alone being considered. The price of the butter is estimated at twenty-five cents per pound and the cost of food is the same as given above.

PROFITS FROM BUTTER PRODUCTION FOR THE FIRST PERIOD OF LACTATION.

(1.) Guernseys	$27 60
(2.) Jerseys	22 15
(3.) Holsteins	5 75

(4.) Holderness	$4 65
(5.) Devons	4 30
(6.) Ayrshires	3 70

FAT LOST AND RECOVERED IN BUTTER-MAKING.

The data presented in the tables below are derived from the monthly averages for the first period of lactation; that is, the first ten months of lactation. In the case of the fat in the cream, skim-milk, buttermilk and butter, the data are presented in two ways; first, the number of pounds of fat lost and recovered in 100 pounds of milk is given; second, the *proportion* of fat in milk lost and recovered is given. For example, in one of the tables given below, under "Fat lost in skim-milk," we see that the Guernseys lost 0.32 pounds of fat in the skim-milk from 100 pounds of milk. The original amount of fat in 100 pounds of the Guernsey milk was 5.02 pounds. The amount of fat lost in the skim-milk is 0.32 pounds and this amount is 6.4 per cent. of 5.02, the amount of fat in the milk. Therefore, we say that the *proportion* or *percentage* of milk-fat lost in the skim-milk is 6.4 per cent. Taking the Jersey skim-milk, the fat lost is 0.37 pounds, while the milk contains 5.68 pounds of fat for each hundred pounds of milk. Here the actual loss of fat in the skim-milk from 100 pounds of milk is greater than in the case of the Guernseys, but the Jersey milk contains more fat to commence with, so that the *proportion* of fat lost is very nearly the same as in the case of the Guernseys, being about 6.5 per cent. of the milk-fat. In the following tables it will be noticed in several cases, that while the *actual* loss of fat is greater in one case than in another, the *proportion* of fat lost is less in the case where the actual loss is greater, since the amount of fat in the milk, at the start, is greater in the latter case.

1. *Pounds of fat in* 100 *pounds of milk.*

(1.) Jerseys	5.68
(2.) Guernseys	5.02
(3.) Devons	4.46
(4.) Holsteins	3.74
(5.) Holderness	3.60
(6.) Ayrshires	3.50

2. *Fat lost in skim-milk.*

Pounds of fat in skim-milk from 100 pounds of milk:

(1.) Guernseys	0.32
(2.) Jerseys	0.37
(3.) Holderness	0.44
(4.) Ayrshires	0.55
(5.) Devons	0.57
(6.) Holsteins	0.68

Percentage of fat in milk lost in skim-milk:

(1.) Guernseys	6.4
(2.) Jerseys	6.5
(3.) Holderness	12.2
(4.) Devons	12.7
(5.) Ayrshires	15.7
(6.) Holsteins	18.2

3. *Fat recovered in cream.*

Pounds of fat in cream from 100 pounds of milk:

(1.) Jerseys	5.31
(2.) Guernseys	4.70
(3.) Devons	3.89
(4.) Holderness	3.16
(5.) Holsteins	3.06
(6.) Ayrshires	2.95

Percentage of fat in milk recovered in cream:

(1.) Guernseys	93.6
(2.) Jerseys	93.5
(3.) Holderness	87.8
(4.) Devons	87.3
(5.) Ayrshires	84.3
(6.) Holsteins	81.8

4. *Fat lost in buttermilk.*

Pounds of fat in buttermilk from 100 pounds of milk:

(1.) Devons	0.03
(2.) Guernseys	0.03
(3.) Holderness	0.05
(4.) Jerseys	0.06
(5.) Ayrshires	0.09
(6.) Holsteins	0.12

Percentage of fat in milk lost in buttermilk:

(1.) Devons	0.7
(2.) Guernseys	1.0
(3.) Jerseys	1.1
(4.) Holderness	1.4
(5.) Ayrshires	2.6
(6.) Holsteins	3.2

5. *Fat recovered in butter.*

Pounds of fat in butter from 100 pounds of milk:

(1.) Jerseys	5.06
(2.) Guernseys	4.57
(3.) Devons	3.67
(4.) Holderness	3.01
(5.) Holsteins	2.79
(6.) Ayrshires	2.77

Percentage of fat in milk recovered in butter:

(1.) Guernseys	91.0
(2.) Jerseys	89.1
(3.) Holderness	83.6
(4.) Devons	82.3
(5.) Ayrshires	79.1
(6.) Holsteins	74.6

6. *Yield of butter.*

Pounds of butter made from 100 pounds of milk:

(1.) Jerseys	5.95
(2.) Guernseys	5.38
(3.) Devons	4.32
(4.) Holderness	3.54
(5.) Holsteins	3.29
(6.) Ayrshires	3.26

7. *Butter-making efficiency of milk-fat.*

Pounds of butter made for one pound of fat in milk:

(1.) Guernseys	1.07
(2.) Jerseys	1.04
(3.) Holderness	0.98
(4.) Devons	0.97
(5.) Ayrshires	0.93
(6.) Holsteins	0.88

SUMMARY OF RESULTS.

a. FAT IN MILK.

The milk of the Jerseys contains the largest amount of fat. Taking the amount of fat in a given amount of Jersey milk as 100, the amount of fat contained in the same quantity of milk of the other breeds will be indicated in the following arrangement:

(1.) Jerseys	100.0
(2.) Guernseys	88.4
(3.) Devons	78.5
(4.) Holsteins	65.8
(5.) Holderness	63.4
(6.) Ayrshires	61.6

b. CREAMING EFFICIENCY OR PROPORTION OF MILK-FAT RECOVERED IN CREAM.

The milk of the Guernseys creamed most completely. For every hundred pounds of fat recovered by the Guernseys in the cream from a certain amount of milk, we shall have the following amounts of fat recovered from the same amount of milk in the case of the other breeds:

(1.) Guernseys	100.0
(2.) Jerseys	99.9
(3.) Holderness	93.8
(4.) Devons	93.3
(5.) Ayrshires	90.0
(6.) Holsteins	87.4

c. PROPORTION OF MILK-FAT RECOVERED IN BUTTER.

The milk-fat of the Guernseys was recovered most completely in the butter. Since the greatest loss of milk-fat in butter-making is in creaming, where gravity processes of creaming are employed, the proportion of milk-fat recovered in the butter follows more or less closely the proportion of milk-fat recovered in the cream. For every hundred pounds of milk-fat recovered in the butter in the case of the Guernseys, the other breeds recover the following amounts:

(1.) Guernseys	100.0
(2.) Jerseys	98.0
(3.) Holderness	91.9

(4.) Devons	90.4
(5.) Ayrshires	86.9
(6.) Holsteins	82.0

d. YIELD OF BUTTER.

As the milk of the Jerseys stands first in the amount of fat contained in it, so it stands first in the actual amount of butter made from 100 pounds of milk. For every hundred pounds of butter made from a certain quantity of Jersey milk, the amounts of butter indicated below will be made from the same amount of milk of the other breeds:

(1.) Jerseys	100.0
(2.) Guernseys	90.4
(3.) Devons	72.6
(4.) Holderness	59.5
(5.) Holsteins	55.3
(6.) Ayrshires	54.8

e. BUTTER-MAKING EFFICIENCY OF MILK-FAT.

Each pound of milk-fat in the Guernsey milk makes more butter than in the case of any other breed. For each hundred pounds of butter made from a certain quantity of milk-fat, the amounts of butter made from the same amount of milk-fat by the other breeds are as follows:

(1.) Guernseys	100.0
(2.) Jerseys	97.2
(3.) Holderness	91.6
(4.) Devons	90.7
(5.) Ayrshires	86.9
(6.) Holsteins	82.2

f. SIMILARITY IN CERTAIN BREEDS.

In examining the preceding tables it will be noticed that in regard to creaming, churning and butter-making efficiency the breeds appear to separate quite sharply into three sets of two each, as follows:

(1.) Guernseys and Jerseys:

Creaming efficiency	93.6 and 93.5
Churning efficiency	91.0 and 89.1
Butter-making efficiency	1.07 and 1.04

(2.) Holderness and Devons:

Creaming efficiency	87.8	and 87.3
Churning efficiency	83.6	and 82.3
Butter-making efficiency	0.98	and 0.97

(3.) Ayrshires and Holsteins:

Creaming efficiency	84.3	and 81.8
Churning efficiency	79.1	and 74.6
Butter-making efficiency	0.93	and 0.88

When we consider the actual amount of fat in butter and amount of butter made from a hundred pounds of milk the uniformity is not as striking, the Holderness then being more like the Ayrshires and Holsteins than like the Devons.

RELATIONS OF MILK, CREAM AND BUTTER.

1. *Relation of milk to butter.*

Pounds of milk required to make one pound of butter:

(1.) Jerseys	16.8
(2.) Guernseys	18.7
(3.) Devons	23.5
(4.) Holderness	28.7
(5.) Ayrshires	30.8
(6.) Holsteins	30.9

2. *Relation of milk to cream.*

Pounds of milk required to make one pound of cream:

(1.) Guernseys	3.72
(2.) Jerseys	3.89
(3.) Devons	5.01
(4.) Holderness	5.51
(5.) Ayrshires	6.27
(6.) Holsteins	6.54

3. *Relation of cream to butter.*

Pounds of cream required to make one pound of butter:

(1.) Jerseys	4.32
(2.) Devons	4.69
(3.) Holsteins	4.74
(4.) Ayrshires	4.91
(5.) Guernseys	5.03
(6.) Holderness	5.09

4. *Fat in cream.*

Per cent. of fat in cream:

(1.) Jerseys	20.66
(2.) Holsteins	19.87
(3.) Devons	18.97
(4.) Ayrshires	18.40
(5.) Holderness	17.43
(6.) Guernseys	17.40

5. *Summary of results.*

a. AMOUNT OF MILK REQUIRED TO MAKE BUTTER.

It required less milk to make one pound of butter in the case of the Jerseys than in the case of any other breed. This is, of course, what might be expected from the results presented already in the preceding pages, since the Jersey milk contains the largest amount of fat and recovers most of it in the butter. If 100 pounds of Jersey milk make a certain amount of butter, the arrangement below indicates how much milk of each breed will be required to make the same amount of butter:

(1.) Jerseys	100.0
(2.) Guernseys	111.3
(3.) Devons	140.0
(4.) Holderness	170.8
(5.) Ayrshires	183.3
(6.) Holsteins	183.9

b. AMOUNT OF MILK REQUIRED TO MAKE CREAM.

Least milk is required to make one pound of cream in the case of the Guernseys. This is largely due to the fact that the cream from the milk of the Guernseys contained the lowest per cent. of fat, and, in addition, the amount of fat in the Guernsey milk was second to the highest. If 100 pounds of Guernsey milk make a certain amount of cream, then, for the other breeds, there will be required, to make the same amount of cream, the amounts of milk given below:

(1.) Guernseys	100.0
(2.) Jerseys	104.6
(3.) Devons	134.7
(4.) Holderness	148.1
(5.) Ayrshires	168.7
(6.) Holsteins	176.0

c. AMOUNT OF CREAM REQUIRED TO MAKE BUTTER.

To make one pound of butter requires least cream in the case of the Jerseys. The amount of cream required to make a pound of butter will depend mainly upon two things, (1st) the per cent. of fat in the cream, and (2d) the loss of fat in churning. If 100 pounds of Jersey cream make a certain amount of butter, then the other breeds will require, in order to make the same amount of butter, the amounts of cream stated below:

(1.) Jerseys	100.0
(2.) Devons	108.6
(3.) Holsteins	109.7
(4.) Ayrshires	113.6
(5.) Guernseys	116.4
(6.) Holderness	118.0

d. PER CENT. OF FAT IN CREAM.

The cream made from the milk of the Jerseys contained most fat. In the case of the other breeds, the amount of fat in the milk seemed to have no definite relation to the amount of fat in the cream. This is a somewhat uncommon experience, it being generally held that by the same method of creaming the richness of the cream in fat will vary with the richness of the milk in fat. The Guernseys stand second in respect to amount of fat in milk, but their cream is least rich in fat. These averages are based upon work extending over a period of ten months and every effort was made to secure uniform conditions in the creaming method employed. They can, therefore, scarcely be regarded as the result of some temporary and incidental irregularity either in the cows or in the methods of creaming. The Holstein milk stands fourth in respect to the amount of its milk-fat, while the cream stands second in richness of fat.

DAILY YIELDS OF MILK AND BUTTER.

During the first period of lactation, the average daily yield of milk and of butter for each breed was as follows:

1. *Daily yield of milk.*

Pounds of milk given per day:

(1.) Holsteins	24.3
(2.) Ayrshires	18.6
(3.) Guernseys	16.6

(4.) Jerseys	14.9
(5.) Holderness	14.9
(6.) Devons	12.0

2. *Daily yield of butter.*

Pounds of butter produced per day:

(1.) Guernseys	0.90
(2.) Jerseys	0.89
(3.) Holsteins	0.79
(4.) Ayrshires	0.61
(5.) Holderness	0.52
(6.) Devons	0.51

3. *Summary of results.*

The Holsteins gave the largest average amount of milk daily, while the Guernseys, closely followed by the Jerseys, gave the largest average daily yield of butter.

AVERAGE MONTHLY YIELDS OF DAIRY PRODUCTS.

1. *Monthly yield of milk.*

Pounds of milk per month:

(1.) Holsteins	743.8
(2.) Ayrshires	578.6
(3.) Guernseys	500.6
(4.) Holderness	449.8
(5.) Jerseys	449.1
(6.) Devons	357.0

2. *Monthly yield of skim-milk.*

Pounds of skim-milk per month:

(1.) Holsteins	630.1
(2.) Ayrshires	485.2
(3.) Holderness	367.8
(4.) Guernseys	365.6
(5.) Jerseys	333.7
(6.) Devons	285.7

3. *Monthly yield of cream.*

Pounds of cream per month:

(1.) Guernseys	135.0
(2.) Jerseys	115.4
(3.) Holsteins	113.7

(4.) Ayrshires	93.4
(5.) Holderness	82.0
(6.) Devons	71.3

4. *Monthly yield of buttermilk.*

Pounds of buttermilk per month:

(1.) Guernseys	108.2
(2.) Holsteins	89.6
(3.) Jerseys	88.7
(4.) Ayrshires	74.6
(5.) Holderness	66.3
(6.) Devons	56.1

5. *Monthly yield of fat in milk.*

Pounds of fat in milk per month:

(1.) Holsteins	27.81
(2.) Jerseys	25.45
(3.) Guernseys	24.96
(4.) Ayrshires	20.20
(5.) Holderness	16.07
(6.) Devons	15.79

6. *Monthly yield of fat in butter.*

Pounds of fat in butter per month:

(1.) Guernseys	22.8
(2.) Jerseys	22.7
(3.) Holsteins	20.5
(4.) Ayrshires	16.0
(5.) Holderness	13.3
(6.) Devons	12.9

7. *Monthly yield of butter.*

Pounds of butter per month:

(1.) Guernseys	26.8
(2.) Jerseys	26.7
(3.) Holsteins	24.1
(4.) Ayrshires	18.8
(5.) Holderness	15.7
(6.) Devons	15.2

8. *Summary of results.*

a. YIELD OF MILK.

The Holsteins gave the largest amount of milk. Below we state the amount of milk given by each breed for 100 pounds of milk given by the Holsteins:

(1.) Holsteins	100.0
(2.) Ayrshires	77.8
(3.) Guernseys	67.3
(4.) Holderness	60.5
(5.) Jerseys	60.4
(6.) Devons	48.0

b. YIELD OF FAT IN MILK.

The average amount of fat given in the milk per month was greatest in the case of the Holsteins. Below we state the pounds of milk-fat given by each breed for 100 pounds of fat in the milk of the Holsteins:

(1.) Holsteins	100.0
(2.) Jerseys	91.5
(3.) Guernseys	89.7
(4.) Ayrshires	72.6
(5.) Holderness	57.8
(6.) Devons	56.8

c. YIELD OF FAT IN BUTTER.

From what was stated in connection with the creaming and churning efficiency of the milk-fat in the case of the different breeds, it is not surprising that the Guernseys, while standing third in the amount of fat yield, should stand first in regard to the amount of fat recovered in the butter. If the milk of the Holsteins did not lose so much fat in creaming, the Holsteins would easily make the largest amount of butter. The question arises as to the best method of getting the fat of the Holsteins from the milk to the butter without such serious loss. This can be accomplished satisfactorily by using a centrifugal machine for creaming the milk. As we propose to use a centrifugal separator in connection with the second period of lactation, the results will be brought out in our future work.

d. YIELD OF BUTTER.

The Guernseys lead in the average monthly yield of butter, the Jerseys very closely following. For each hundred pounds of butter made by the Guernseys, the other breeds produced the amounts indicated below:

(1.) Guernseys	100.0
(2.) Jerseys	99.7
(3.) Holsteins	89.9
(4.) Ayrshires	70.2
(5.) Holderness	58.6
(6.) Devons	56.7

TEMPERATURE AND TIME OF CHURNING.

1. *Temperature of churning.*

Degrees Fahrenheit in churning:

(1.) Jerseys	62.3°
(2.) Holsteins	63.3°
(3.) Guernseys	63.4°
(4.) Ayrshires	63.5°
(5.) Holderness	63.5°
(6.) Devons	66.6°

2. *Time of churning.*

Minutes for churning:

(1.) Guernseys	31
(2.) Ayrshires	43
(3.) Devons	51
(4.) Jerseys	56
(5.) Holderness	73
(6.) Holsteins	91

FAT GLOBULES OF MILK.

Below we give data pertaining to (1st) relative number of fat globules and (2d) relative size of fat globules. The methods employed in determining these data are those devised by Dr. S. M. Babcock and described in the fourth annual report of this Station.

The *relative number* of fat globules is ascertained directly by counting the globules by means of a microscope in a known amount of milk. For the sake of comparison, it is desirable to know how many globules there are in some particular volume.

The volume of milk adopted as a standard for the sake of comparing the number of fat globules is one-ten-thousandth of a cubic millimeter, one cubic millimeter occupying about the volume of an ordinary pin-head. By using so small an amount of milk, we get numbers which are not too large to comprehend, and which answer satisfactorily for the purposes of comparison. The *relative number* of fat globules means, therefore, the number in one-ten-thousandth (.0001) of one cubic millimeter of milk.

If we know the volume of fat and the number of globules in that volume, we can readily ascertain the average volume or size of one globule by dividing the volume of fat by the number of globules. Since we desire only relative numbers for the sake of comparison, it answers the purpose to take the per cent. of fat in the milk, obtained by analysis, as representing the volume of fat. If, then, we divide the per cent. of fat in the milk by the number of globules in .0001 cubic millimeters of milk, we shall obtain the average relative volume or size of one globule. As the number thus obtained is too small for convenient use, it is multiplied by 10,000, and the number obtained is used to represent the *relative size* of the fat globules. The numbers representing the relative size of the fat globules do not, therefore, represent any actual size or volume, nor can they be referred to one standard of size; but, by proceeding in the manner described with different milks, we get numbers which can be compared and which represent, relatively to one another, the average size or volume of the fat globules in the different milks. As pointed out by Doctor Babcock, the average diameter of globules would not serve well for comparison, unless the globules were uniform in size or nearly so. "But as the volumes of spheres vary, not directly as their diameters, but as the cubes of their diameters, and as the average of a series of numbers does not determine what the average of their cubes will be, it follows, with bodies varying to the extent often occurring in the fat globules of milk, that their average diameter conveys no definite idea of their volume, which is really, in most cases, what is sought. The average volume of milk globules, owing to their variable size, is always greater than the volume indicated by their average diameter, the difference between two volumes being greatest when the globules vary most in size. It is, therefore, evident that if we wish to study the influence of the size of globules upon the character of milk, their volume rather than their average diameter should be considered." (Fourth Annual Report of this Station, page 297.)

1. *Relative number of fat globules.*

Number of globules in .0001 c. mm. of milk:

(1.) Jerseys	69
(2.) Guernseys	79
(3.) Holderness	92
(4.) Holsteins	103
(5.) Ayershires	106
(6.) Devons	147

2. *Relative size of fat globules.*

Relative size of globules:

(1.) Jerseys	956
(2.) Guernseys	716
(3.) Holderness	428
(4.) Ayrshires	421
(5.) Holsteins	405
(6.) Devons	375

There appears to be a general relation between the relative number of fat globules and the creaming and churning efficiency, the milk containing the fewer number being more efficient for butter-making. In regard to the relative size of the fat globules, the larger the size, the more efficient the creaming and churning, which we see is borne out in a general way by the foregoing numbers, though modified in some cases by other factors.

GENERAL SUMMARY OF RESULTS RELATING TO BUTTER-PRODUCTION OF DIFFERENT BREEDS.

The more important results that have been presented in the foregoing tables are summarized in the table presented below. As previously stated, these results are not complete, and they must not be regarded as conclusive. Following this summary, we present tables containing data pertaining to the averages of each breed, and, finally, tables containing the records of the various individuals of each breed. Since only one Holstein (Esel 2nd) is considered in the averages for herds, her average at present constitutes the herd average, and is not repeated. So, no Holstein herd average appears.

TABULATED SUMMARY OF RESULTS FOR THE FIRST PERIOD OF LACTATION.

	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
Monthly average cost of food consumed	$4 33	$3 37	$3 94	$3 46	$5 45	$4 46
Food-cost of each pound of butter produced	0 23	0 22	0 15	0 22	0 23	0 17
Profits from butter production for period	3 70	4 30	27 60	4 65	5 75	22 15
Pounds of fat in 100 pounds of milk	3.50	4.46	5.02	3.60	3.74	5.68
Per cent. of fat in milk lost in skim-milk	15.70	12.70	6.40	12.20	18.20	6.50
Per cent. of fat in milk recovered in cream	84.30	87.30	93.60	87.80	81.80	93.50
Per cent. of fat in milk lost in buttermilk	2.60	0.70	1.00	1.40	3.20	1.10
Per cent. of fat in milk recovered in butter	79.10	82.30	91.00	83.60	74.60	89.10
Pounds of butter from 100 pounds of milk	3.26	4.32	5.38	3.54	3.29	5.95
Pounds of butter made for one pound of fat in milk	0.98	0.97	1.07	0.98	0.88	1.04
Pounds of milk required to make one pound of butter	30.80	23.50	18.70	23.70	30.90	16.80
Pounds of milk required to make one pound of cream	6.27	5.01	3.72	5.51	6.54	3.89
Pounds of cream required to make one pound of butter	4.91	4.69	5.03	5.09	4.74	4.32
Per cent. of fat in cream	18.40	18.97	17.40	17.43	19.87	20.66
Pounds of milk given per day	18.60	12.00	16.60	14.00	24.30	14.90
Pounds of butter produced per day	0.61	0.51	0.90	0.52	0.79	0.89
Pounds of milk given per month	578.60	357.00	500.60	449.80	743.80	449.10
Pounds of fat in milk per month	20.20	15.79	24.96	16.07	27.81	25.45
Pounds of butter per month	18.80	15.20	26.80	15.70	24.10	26.70

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF HERD.

MONTH OF LACTATION.	CHURNING.			FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
	Average temperature during churning.	Time of churning.	Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
	Degrees.	Hrs. Min.									
1	62	 28	18.00	3.53	0.35	3.18	0.05	3.07	3.60	62	687
2	61	... 30	20.55	3.48	0.29	3.19	0.07	3.06	3.60	66	580
3	62	 34	19.20	3.40	0.42	2.98	0.11	2.76	3.25	70	624
4	61	 35	19.68	3.40	0.38	3.02	0.10	2.80	3.29	85	426
5	64	 35	20.14	3.37	0.39	2.98	0.09	2.79	3.28	93	384
6	65	 41	16.12	3.26	0.52	2.74	0.06	2.65	3.12	94	399
7	64	1 00	16.95	3.48	0.78	2.70	0.12	2.49	2.96	117	328
8	65	 41	17.31	3.61	0.91	2.70	0.12	2.46	2.90	140	298
9	65	1 02	18.19	3.68	0.67	3.01	0.06	2.77	3.29	168	241
0	66	1 00	17.88	3.83	0.82	3.01	0.13	2.80	3.31	162	248
1	64	 53	16.72	4.10	0.89	3.21	0.25	2.89	3.40	156	336
	68	 31	16.10	3.84	0.15	3.69	0.11	3.56	4.19	146	328

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF HERD — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	27.80	5.64	5.00	0.55	260.2	214.1	46.1	36.9	7.8	9.2	90.9	9.1	1.3	87.6
2	27.80	6.30	4.51	0.75	636.3	525.3	110.0	87.7	19.0	22.3	92.1	7.9	1.9	88.7
3	30.75	6.52	4.87	0.65	596.4	504.9	91.5	72.7	16.0	18.8	87.9	12.1	3.2	82.1
4	30.40	6.56	4.73	0.67	642.7	544.7	98.0	77.3	17.6	20.7	88.7	11.3	2.7	82.8
5	30.50	6.85	4.56	0.65	611.2	522.0	89.2	69.7	16.6	19.5	88.1	11.9	2.3	82.6
6	32.05	5.92	5.63	0.59	619.1	514.5	104.6	86.0	15.8	18.6	82.7	17.3	1.8	79.9
7	33.80	6.54	5.36	0.58	609.2	516.1	93.1	75.7	14.8	17.4	78.0	22.0	3.2	72.5
8	34.48	6.84	5.28	0.52	545.7	466.0	79.7	64.3	13.1	15.4	77.0	23.0	3.2	71.0
9	30.40	6.08	5.28	0.57	539.5	450.8	88.7	71.6	14.5	17.1	82.7	17.3	1.7	77.0
10	30.20	5.43	5.30	0.53	512.4	418.1	94.3	76.4	15.2	17.9	89.8	10.2	1.4	87.4
11	29.36	5.40	5.09	0.64	537.8	438.2	99.6	79.9	16.7	19.7	90.8	9.2	6.9	82.9
12	23.87	4.37	5.50	0.64	476.0	367.0	109.0	89.3	16.7	19.7	96.4	3.6	3.0	92.8

*First month of lactation averaged sixteen and one-half days.

DEVON BUTTER RECORD — MONTHLY AVERAGES OF HERD.

MONTH OF LACTATION.	CHURNING.				FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.	Relative number of fat globules.	Relative size of fat globules.
	Degrees.	Hrs.	Min.									
1	64	....	35	17.42	3.54	0.20	3.34	0.01	3.32	3.91	68	546
2	65	....	31	18.56	3.73	0.38	3.35	0.02	3.28	3.86	68	585
3	64	....	36	19.40	3.96	0.53	3.43	0.02	3.32	3.91	99	450
4	67	1	10	17.90	4.28	0.55	3.73	0 01	3.60	4.24	77	547
5	66	....	39	19.92	4.43	0.77	3.66	0.03	3.30	3.88	152	319
6	67	1	8	19.70	5.06	0.83	4.23	0.03	3.92	4.61	144	355
7	68	....	53	16.68	4.93	1.21	3.72	0.04	3.25	3.83	186	270
8	68	1	31	17.44	4.44	1.04	3.40	0.02	3.38	3.98	241	200
9	69	....	55	23.14	5.57	0.11	5.46	0.09	4.88	5.74	225	250

DEVON BUTTER RECORD — MONTHLY AVERAGES OF HERD — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent of fat recovered in butter.
1*	25.60	5.23	4.92	0.51	205.9	166.5	39.4	31.4	6.8	8.0	94.3	5.7	0.4	93.7
2	25.76	5.54	4.70	0.54	418.3	342.8	75.5	59.5	13.6	16.0	90.0	10.0	0.5	88.2
3	25.60	5.66	4.54	0.54	428.4	352.7	75.7	59.0	14.2	16.7	86.6	13.4	0.5	83.9
4	23.60	4.85	4.94	0.56	398.8	316.6	82.2	65.6	14.1	16.6	86.7	13.3	0.3	84.0
5	25.82	5.48	4.71	0.46	362.8	296.6	66.2	52.1	12.0	14.1	82.3	17.7	0.7	74.4
6	21.69	4.82	4.70	0.50	335.2	265.2	70.0	55.2	12.6	14.8	82.6	17.4	0.5	77.0
7	26.12	4.48	5.83	0.41	323.5	251.3	72.2	59.8	10.5	12.4	75.3	24.7	0.8	66.0
8	25.13	5.13	4.90	0.45	346.0	278.6	67.4	53.7	11.7	13.8	76.6	23.4	0.5	76.0
9	17.42	4.23	4.12	0.60	311.9	238.2	73.7	55.8	15.2	17.9	98.0	2.0	1.6	87.6

* First month of lactation averaged nineteen and one-half days.

GUERNSEY BUTTER RECORD — MONTHLY AVERAGES OF HERD.

MONTH OF LACTATION.	CHURNING.				FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
	Degrees.	Hrs.	Min.									
1	60	....	17	21.42	6.14	0.16	5.98	0.17	5.75	6.76	61	928
2	61	....	19	18.14	5.13	0.18	4.95	0.05	4.76	5.59	46	1,063
3	63	....	32	16.61	4.61	0.25	4.37	0.03	4.24	5.04	52	954
4	62	....	36	14.85	4.63	0.19	4.42	0.02	4.37	5.14	76	659
5	62	....	34	18.72	5.00	0.20	4.80	0.02	4.66	5.48	64	837
6	62	....	44	18.74	4.93	0.37	4.56	0.02	4.42	5.20	70	737
7	64	....	32	17.03	4.83	0.46	4.37	0.04	4.23	4.98	103	584
8	65	....	42	16.18	4.86	0.37	4.49	0.03	4.43	5.20	89	568
9	66	....	26	16.16	4.92	0.34	4.58	0.05	4.52	5.32	120	408
10	60	....	28	16.10	5.14	9.69	4.45	0.10	4.35	5.12	104	426
11	68	....	41	23.57	5.63	0.25	5.38	0.22	4.77	5.61	136	528
12	70	....	26	22.44	5.64	0.30	5.34	0.23	5.10	6.01	118	550

GUERNSEY BUTTER RECORD — MONTHLY AVERAGES OF HERD — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	14.95	3.64	4.24	0.89	250.4	181.7	68.7	52.5	13.8	16.2	97.3	2.7	1.3	93.0
2	17.90	3.66	4.93	0.89	491.7	357.6	134.1	106.7	23.3	27.4	96.5	3.5	0.8	93.0
3	19.82	3.76	5.29	0.89	520.0	381.7	138.3	112.1	22.3	26.2	94.7	5.3	0.6	92.3
4	19.51	3.34	5.87	0.89	509.3	356.8	152.5	126.4	22.2	26.1	95.9	4.1	0.5	94.4
5	18.25	3.88	4.70	0.95	529.6	393.1	136.5	107.5	24.7	29.0	96.1	3.9	0.4	93.0
6	19.22	4.13	4.67	0.91	530.0	401.7	128.3	100.5	23.4	27.5	92.6	7.4	0.4	89.6
7	20.04	3.91	5.17	0.88	537.0	399.7	137.3	110.8	22.5	26.5	90.4	9.6	0.3	87.6
8	19.22	3.63	5.30	0.90	527.0	381.8	145.2	117.8	23.3	27.4	92.6	7.4	0.6	91.3
9	18.80	3.54	5.39	0.88	512.2	367.5	144.7	117.9	22.8	26.8	93.1	6.9	1.2	91.5
10	19.53	3.66	5.35	0.78	463.7	337.1	126.6	102.9	20.1	23.7	86.8	13.2	2.0	84.7
11	17.90	4.38	4.09	0.84	451.1	348.1	103.0	77.8	21.4	25.2	95.8	4.2	4.6	85.0
12	16.67	4.22	3.95	0.87	441.2	336.7	104.5	78.0	22.5	26.5	94.9	5.1	5.6	90.7

* First month of lactation averaged nineteen and one-half days.

AMERICAN HOLDERNESS BUTTER RECORD — MONTHLY AVERAGES OF HERD.

MONTH OF LACTATION.	CHURNING.				FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
	Degrees.	Hrs.	Min.									
1	60	1	06	23.22	5.04	0.63	4.41	0.12	4.15	4.88	......	......
2	60	....	53	20.79	3.61	0.42	3.19	0.05	2.97	3.51	67	661
3	60	....	49	18.99	3.37	0.38	2.99	0.07	2.77	3.26	68	607
4	62	1	16	16.29	3.44	0.42	3.02	0.04	2.94	3.45	87	501
5	65	1	25	15.21	3.33	0.43	2.90	0.02	2.82	3.31	79	397
6	66	1	26	13.79	3.33	0.36	2.97	0.05	2.90	3.42	104	324
7	66	1	42	15.30	3.35	0.33	3.02	0.04	2.98	3.49	111	329
8	63	1	12	18.52	3.49	0.44	3.05	0.02	2.94	3.45	94	379
9	66	....	56	17.65	3.59	0.56	3.03	0.03	2.97	3.50	116	315
10	67	1	23	14.58	3.44	0.41	3.03	0.08	2.64	3.10	106	336
11	68	1	32	17.95	3.33	0.35	2.98	0.03	2.91	3.43	146	235
12	69	....	45	16.15	3.45	0.42	3.03	0.07	2.78	3.27	160	246

AMERICAN HOLDERNESS BUTTER RECORD — MONTHLY AVERAGES OF HERD — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	20.45	5.29	3.90	0.58	150.8	122.3	28.5	21.2	6.2	7.3	87.8	12.2	2.2	82.4
2	28.50	6.49	4.48	0.61	541.2	457.8	83.4	64.8	15.8	18.6	88.2	11.8	1.3	82.3
3	30.67	6.35	4.86	0.61	558.6	470.6	88.0	69.9	15.4	18.1	88.5	11.5	2.2	82.1
4	29.00	5.38	5.44	0.55	489.2	398.3	90.9	74.1	14.3	16.8	87.2	12.8	1.0	85.4
5	30.20	5.26	5.76	0.52	483.9	392.1	91.8	75.8	13.6	16.0	88.7	11.3	0.7	84.7
6	29.24	4.63	6.36	0.51	416.6	326.6	90.0	75.8	12.1	14.2	88.9	11.1	1.5	87.1
7	28.70	5.07	5.66	0.48	425.0	341.2	83.8	69.0	12.6	14.8	90.2	9.8	1.1	88.7
8	29.00	6.06	4.78	0.45	390.7	326.2	64.5	51.0	11.5	13.5	87.4	12.6	0.4	84.2
9	28.60	5.84	4.91	0.47	407.8	337.8	70.0	55.8	12.1	14.2	84.5	15.5	0.8	82.9
10	32.76	4.75	6.89	0.42	407.6	321.6	86.0	73.6	10.5	12.4	87.9	12.1	2.3	81.8
11	29.19	6.02	4.85	0.46	416.9	347.7	69.2	54.9	12.2	14.3	90.0	10.0	1.8	88.0
12	30.69	5.35	5.73	0.41	391.8	318.6	73.2	60.5	10.8	12.7	87.9	12.1	1.5	80.6

* First month of lactation averaged twelve days.

JERSEY BUTTER RECORD — MONTHLY AVERAGES OF HERD.

MONTH OF LACTATION.	CHURNING.				FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
	Degrees.	Hrs.	min.									
1	61	....	33	24.17	6.10	0.44	5.66	0.15	5.23	6.15	49	1104
2	61	....	46	20.06	5.27	0.40	4.87	0.10	4.56	5.36	53	1098
3	62	....	38	21.20	5.18	0.25	4.93	0.08	4.56	5.36	45	1228
4	60	....	53	21.52	5.75	0.25	5.50	0.04	5.11	6.01	86	1097
5	61	1	03	20.84	5.68	0.41	5.27	0.04	5.13	6.03	56	1149
6	62	1	11	18.50	5.73	0.52	5.21	0.11	4.90	5.77	76	846
7	64	1	32	19.70	5.72	0.31	5.41	0.04	5.19	6.11	62	1017
8	64	....	57	20.83	5.80	0.29	5.51	0.04	5.39	6.35	80	733
9	63	....	55	21.04	5.76	0.39	5.37	0.02	5.17	6.08	83	715
10	65	....	53	18.78	5.81	0.41	5.40	0.03	5.31	6.24	103	571
11	65	....	43	16.33	5.39	0.35	5.04	0.03	4.97	5.84	93	594
12	65	....	36	19.11	5.56	0.25	5.31	0.06	5.09	5.99	113	605

JERSEY BUTTER RECORD — MONTHLY AVERAGES OF HERD — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	16.30	4.19	3.89	0.98	341.1	259.7	81.4	60.5	17.8	20.9	92.7	7.3	2.5	85.7
2	18.65	4.17	4.53	0.98	527.3	400.9	126.4	98.5	23.7	27.9	92.4	7.6	1.8	86.7
3	18.65	4.22	4.44	0.94	487.8	372.2	115.6	89.6	22.1	26.0	95.1	4.9	1.5	88.2
4	16.64	3.93	4.31	0.97	452.5	337.4	115.1	88.4	22.7	26.7	95.8	4.2	0.7	88.6
5	16.60	3.94	4.21	0.94	484.3	361.3	123.0	93.8	24.8	29.2	92.9	7.1	0.7	90.5
6	17.22	3.59	4.87	0.86	443.6	320.0	123.6	98.2	21.6	25.4	91.2	8.8	1.9	86.0
7	16.26	3.63	4.53	0.83	408.7	296.1	112.6	87.8	21.1	24.8	94.6	5.4	0.5	91.0
8	15.80	3.77	4.19	0.82	395.7	290.7	105.0	80.0	21.2	25.0	95.2	4.8	0.6	93.2
9	16.44	3.93	4.20	0.81	407.9	304.1	103.8	79.1	21.0	24.7	93.8	6.2	0.3	88.8
10	16.03	3.51	4.60	0.80	395.7	283.0	112.7	91.9	20.8	24.5	93.0	7.0	0.5	91.4
11	17.53	3.27	5.36	0.75	378.4	262.7	115.7	94.1	18.4	21.6	93.7	6.3	0.6	92 4
12	16.90	3.64	4.64	0.74	379.0	274.9	104.1	81.7	19.0	22.4	95.4	4.6	1.1	91.8

*First month of lactation averaged twenty-one days.

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF JUNIETTA PEERLESS.*

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees	Degrees	Hrs.	Min.									
1	February, 1891	38	64		37	15.87	3.05	0.13	2.92	0.06	2.85	3.34	87	379
2	March, 1891	37	63	....	41	17.06	2.97	0.16	2.81	0.02	2.77	3.26	84	392
3	April, 1891	44	64	....	46	18.83	2.90	0.31	2.59	0.03	2.50	2.94	87	370
4	May, 1891	47	64	....	42	17.74	2.86	0.38	2.48	0.03	2.44	2.87	86	336
5	June, 1891	46	67	....	40	17.66	2.77	0.35	2.42	0.02	2.28	2.68	84	362
6	July, 1891	47	67	....	44	11.95	2.72	0.76	1.96	0.02	1.98	2.33	121	226
7	August, 1891	47	67	1	52	13.12	2.91	0.89	2.02	0.08	1.93	2.38	149	202
8	September, 1891	46	72	....	35	13.31	3.35	0.94	2.41	0.01	2.33	2.74	226	156
9	October, 1891	46	69	1	40	13.69	3.08	0.53	2.55	0.03	2.36	2.78	271	107
10	November, 1891	....	69	2	0	14.34	2.91	0.10	2.81	0.03	2.75	3.24	194	155

* Junietta Peerless dropped calf at eighth month of pregnancy and her condition has been not entirely normal.

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF JUNIETTA PEERLESS — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	29.85	5.43	5.50	0.50	193.5	157.9	35.0	29.1	5.5	1.5	95.7	4.3	1.9	93.4
2	30.99	6.02	5.15	0.47	453.5	378.2	75.3	60.7	12.4	14.6	94.5	5.5	0.8	93.4
3	34.23	7.24	4.73	0.45	462.6	398.7	63.9	50.4	11.5	13.5	89.3	10.7	1.2	86.0
4	34.85	7.14	4.88	0.47	512.4	440.6	75.8	51.7	12.5	14.7	86.5	13.5	1.0	85.3
5	37.57	7.30	5.15	0.43	487.0	420.3	66.7	53.8	11.0	12.9	87.5	12.5	0.7	82.5
6	42.92	6.10	7.05	0.37	488.9	408.8	80.1	68.7	9.7	11.4	71.3	28.7	0.9	70.2
7	39.92	6.49	6.15	0.39	486.1	411.2	74.9	62.7	10.4	12.2	69.5	30.5	2.8	66.5
8	36.50	6.95	5.25	0.39	427.1	365.7	61.4	49.7	9.9	11.7	71.9	28.1	0.3	69.6
9	35.97	5.40	6.66	0.39	435.8	355.1	80.7	68.6	10.3	12.1	82.8	17.2	1.0	76.6
10	30.86	5.10	6.05	0.44	410.1	329.7	80.4	67.1	11.3	13.3	96.6	3.4	1.0	94.5

*First month of lactation contains thirteen days.

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF MANTON BELLE.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.				FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs.	Min.									
1	December, 1890	41	60	....	19	20.12	4.00	0.56	3.44	0.03	3.28	3.86	41	995
2	January, 1891	41	62	....	19	16.34	3.10	0.20	2.90	0.06	2.79	3.28	58	539
3	February, 1891	38	62	....	23	16.47	2.82	0.31	2.51	0.13	2.37	2.79	90	316
4	March, 1891	38	64	....	28	19.47	3.42	0.39	3.03	0.01	3.01	3.53	83	453
5	April, 1891	44	63	....	30	21.24	3.40	0.50	2.90	0.01	2.80	3.30	90	409
6	May, 1891	44	65	....	28	18.06	3.27	0.42	2.85	0.02	2.80	3.30	97	354
7	June, 1891	44	66	....	37	16.25	3.36	0.24	3.12	0.11	2.89	3.40	71	472
8	July, 1891	46	66	....	35	17.10	3.22	0.33	2.89	0.09	2.71	3.19	132	253
9	August, 1891	47	68	....	25	18.27	3.42	0.46	2.96	0.07	2.82	3.32	136	237
10	September, 1891	47	70	....	32	16.21	3.75	0.80	2.95	0.10	2.79	3.28	137	281
11	October, 1891	....	67	1	5	17.17	3.84	0.20	3.64	0.50	3.14	3.69	244	217
12	November, 1891	....	69	....	30	16.20	4.00	0.08	3.92	0.06	3.86	4.54	206	213

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF MANTON BELLE — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1*	26.52	5.85	4.53	0.65	327.8	271.8	56.0	43.6	10.5	12.4	86.0	14.0	0.8	81.8
2	30.64	5.56	5.51	0.69	649.6	532.8	116.8	95.6	18.0	21.2	93.7	6.3	2.2	90.1
3	36.05	6.58	5.48	0.65	655.4	555.8	99.6	81.4	15.5	18.2	88.9	11.1	4.9	83.9
4	29.12	6.41	4.54	0.79	714.2	602.8	111.4	86.9	20.8	24.5	88.9	11.1	0.3	88.2
5	30.35	7.30	4.16	0.76	688.8	594.5	94.3	71.6	19.3	22.7	85.5	14.5	0.3	82.4
6	30.37	6.33	4.80	0.70	664.5	559.5	105.0	83.1	18.6	21.9	87.1	12.9	0.6	85.6
7	29.41	5.21	5.64	0.74	652.1	527.0	125.1	102.9	18.9	22.2	92.8	7.2	3.3	86.1
8	31.54	5.91	5.33	0.67	657.3	546.1	111.2	90.4	17.7	20.8	89.9	10.1	2.9	83.9
9	30.15	6.17	4.88	0.63	588.7	493.3	95.4	75.9	16.6	19.5	86.7	13.3	3.2	82.9
10	30.54	5.50	5.55	0.51	464.7	380.2	84.5	69.3	12.9	15.2	78.8	21.2	2.7	74.5
11	27.10	5.00	5.42	0.46	385.0	308.0	77.0	62.8	12.1	14.2	94.8	5.2	13.0	81.8
12	22.03	4.13	5.33	0.41	271.1	205.5	65.6	53.3	10.5	12.3	98.0	2.0	1.5	96.5

* First month of lactation contains twenty days.

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF MISS FLOW 5TH.*

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs.	Min.									
7	August, 1890	51	60	....	50	22.74	4.05	1.72	2.33	0.24	1.92	2.26	131	293
8	September, 1890	51	60	1	00	23.72	4.54	2.06	2.48	0.29	1.91	2.24	95	476
9	October, 1890	49	60	1	5	23.36	4.34	1.50	2.84	0.14	2.33	2.74	......	....
10	November, 1890	48	63	....	57	21.11	4.95	2.14	2.81	0.36	2.24	2.63	185	268
11	December, 1890	42	62	1	10	13.31	4.80	2.01	2.79	0.23	2.44	2.87	125	402

*First period of lactation.

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF MISS FLOW 5TH* — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
7	44.53	9.75	4.57	0.40	551.7	495.1	56.6	44.2	10.5	12.4	57.5	42.5	5.9	47.4
8	44.79	9.52	4.70	0.34	449.5	402.3	47.2	37.2	8.5	10.0	54.7	45.3	6.4	42.2
9	37.08	8.20	4.52	0.37	431.5	378.5	53.0	41.3	9.9	11.7	65.6	34.4	3.3	53.5
10	38.73	7.52	5.15	0.29	333.9	289.5	44.4	35.8	7.3	8.6	56.7	43.3	7.4	45.2
11	35.00	4.94	7.08	0.16	173.9	138.7	35.2	30.2	4.3	5.0	58.3	41.7	4.9	50.8

* First period of lactation.

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF MISS FLOW 5TH.*

MONTH OF LACTATION.	Date.		CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
			Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
			Degrees.	Degrees.	Hrs.	Min.									
1	March,	1891	38	63	....	33	19.05	3.97	0.29	3.68	0.03	3.57	4.20	73	570
2	April,	1891	43	63	....	27	19.08	3.09	0.40	2.69	0.04	2.65	3.12	77	423
3	May,	1891	45	64	....	35	18.50	2.93	0.65	2.28	0.03	2.24	2.64	103	365
4	June,	1891	48	66	....	37	17.85	3.16	0.34	2.82	0.12	2.42	2.84	61	549
5	July,	1891	46	66	1	7	17.24	3.19	0.69	2.50	0.04	2.45	2.89	146	243
6	August,	1891	47	68	....	46	16.13	3.47	0.84	2.63	0.09	2.32	2.73	146	234
7	September,	1891	47	70	....	29	17.08	3.90	1.68	2.22	0.08	2.09	2.46	128	312
8	October,	1891	....	66	1	10	19.00	3.73	0.12	3.61	0.30	3.30	3.88	206	183
9	November,	1891	....	70	....	46	15.25	3.77	0.08	3.69	0.06	3.63	4.27	175	198

* Second period of lactation.

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF MISS FLOW 5TH*— (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1	24.19	5.13	4.71	0.72	541.4	435.9	105.5	83.1	19.0	22.4	92.6	7.4	0.8	89.7
2	32.10	7.04	4.56	0.60	581.7	499.1	82.6	64.5	15.4	18.1	87.1	12.9	0.7	85.8
3	38.00	8.00	4.75	0.53	624.2	546.2	78.0	61.6	13.9	16.4	77.8	23.2	0.8	76.6
4	35.26	6.33	5.57	0.57	604.8	509.2	95.6	78.4	14.6	17.2	89.4	10.6	3.9	76.7
5	35.15	6.90	5.09	0.52	566.2	484.2	82.0	65.9	13.7	16.1	78.2	21.8	1.4	76.7
6	36.56	6.14	5.95	0.47	533.2	446.4	86.8	72 2	12.4	14.6	75.9	24.1	2.7	67.1
7	40.77	7.70	5.30	0.37	452.2	393.5	58.7	47.6	9.4	11.1	56.9	43.1	2.0	53.6
8	25.77	5.26	5.90	0.57	456.2	369.5	86.7	69.0	15.0	17.7	96.8	3.2	8.7	88.5
9	23.42	4.13	5.67	0.58	410.0	310.8	99.2	81.7	14.9	17.5	97.9	2.1	1.5	96.3

* Second period of lactation.

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF QUEEN DUCHESS.

MONTH OF LACTATION.	Date.	Creaming and Churning.					From 100 Pounds of Milk.						Microscopic Data.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs.	Min.									
2	August, 1890	48	59	....	30	28.26	4.37	0.51	3.86	0.13	3.62	4.26	56	808
3	September, 1890	47	61	....	34	22.28	4.48	0.65	3.83	0.16	3.42	4.02	34	1185
4	October, 1890	49	61	....	34	21.83	3.93	0.37	3.56	0.27	2.94	3.46	87	490
5	November, 1890	47	61	....	36	21.52	3.95	0.34	3.61	0.24	3.28	3.86	105	380
6	December, 1890	42	62	....	50	18.34	3.78	0.38	3.40	0.14	3.17	3.73	64	618
7	January, 1891	39	62	....	43	15.71	3.60	0.29	3.31	0.03	3.23	3.80	......	....
8	February, 1891	39	62	....	36	15 09	3.31	0.28	3.03	0.10	2.90	3.44	108	308
9	March, 1891	37	63	....	58	17.43	3.86	0.16	3.70	0.02	3.56	4.31	98	378
10	April, 1891	44	64	....	33	19.87	3.71	0.23	3.48	0.02	3.40	4.08	130	287
11	May, 1891	48	64	....	25	19.69	3.67	0.48	3.19	0.03	3.08	3.63	98	388
12	June, 1891	47	67	....	32	15.90	3.65	0.20	3.45	0.16	3.26	3.83	86	442
13	July, 1891	46	66	....	52	16.67	3.68	0.28	3.40	0.12	3.27	3.85	115	316
14	August, 1891	48	68	....	50	15.27	4.10	0.48	3.62	0.03	3.58	4.22	142	289
15	September, 1891	47	71	....	20	14.34	3.70	0.67	3.03	0.34	2.69	3.16	203	187
16	October, 1891	....	72	....	45	20.23	5.30	0.12	5.18	0.12	4.38	5.15	320	166

AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF QUEEN DUCHESS — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
2	23.73	7.32	3.24	1.10	805.7	695.7	110.0	76.1	28.8	33.9	88.1	11.9	2.8	82.5
3	24.97	5.75	4.34	0.90	671.1	554.4	116 7	89.8	22.9	26.9	85.4	14.6	3.6	76.4
4	29.12	6.13	4.75	0.78	701.6	587.2	114.4	90.3	20.5	24.1	90.6	9.4	6.8	75.0
5	25.90	5.95	4.35	0.85	657.8	547.8	110.0	84.6	21.6	25.4	91.4	8.6	6.0	82.9
6	26.85	5.32	5.04	0.85	703.9	571.6	132.3	106.1	22.3	26.2	89.7	10.3	3.8	84.0
7	26.33	4.72	5.58	0.91	747.1	588.8	158.3	130.0	24.7	28.3	92.1	7.9	0.8	89.9
8	29.11	4.98	5.84	0.80	649.0	518.7	130.3	108.0	19.0	22.3	91.5	8.5	3.0	88.2
9	23.23	4.57	5.08	0.97	702.2	548.6	153.6	123.4	25.7	30.2	95.9	4.1	0.4	95.1
10	24.51	5.68	4.31	0.90	662.4	545.8	116.6	89.6	23.0	27.0	94.0	6.0	0.5	93.2
11	27.61	5.81	4.75	0.81	690.6	571.8	118.8	86.9	21.3	25.0	86.7	13.3	0.8	83.9
12	26.17	4.61	5.68	0.87	680.9	533.2	147.7	121.7	22.1	26.0	94.7	5.3	4.6	89.1
13	25.97	4.90	5.30	0.83	673.5	536.0	137.5	111.6	22.0	25.9	92.5	7.5	3.5	88.9
14	24.06	4.22	5.70	0.75	558.0	425.8	132.2	109.0	19.7	23.2	88.6	11.4	0.9	87.6
15	31.62	4.71	6.71	0.38	363.3	286.2	77.1	65.6	9.8	11.5	81.9	18.1	9.2	72.7
16	19.42	3.90	4.98	0.20	122.4	91.0	31.4	25.1	5.4	6.3	97.7	2.3	2.2	82.6

DEVON BUTTER RECORD — MONTHLY AVERAGES OF GENEVIE'S GIFT.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs.	Min.									
1*	May, 1891	45	64	....	41	16.52	3.25	0.16	3.09	0.01	3.07	3.61	56	575
2	June, 1891	46	66	....	27	16.95	3.42	0.20	3.22	0.02	3.14	3.69	48	681
3	July, 1891	46	64	....	35	19.33	3.99	0.49	3.50	0.02	3.43	4.04	119	380
4	August, 1891	47	67	1	55	18.97	4.68	0.48	4.20	0.01	4.04	4.75	88	522
5	September, 1891	47	67	....	32	21.24	4.95	0.83	4.12	0.02	3.44	4.05	131	428
6	October, 1891	....	66	1	05	22.09	5.58	0.30	5.28	0.04	4.70	5.53	154	363

* First month of lactation contains fifteen days.

DEVON BUTTER RECORD — MONTHLY AVERAGES OF GENEVIE'S GIFT — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1	27.70	5.35	5.18	0.48	158.8	129.1	29.7	24.0	4.8	5.7	95.1	4.9	0.3	94.5
2	27.25	5.26	5.18	0.50	403.7	327.0	76.7	61.9	12.6	14.8	94.1	5.9	0.7	91.7
3	24.90	5.53	4.50	0.50	383.1	313.8	69.3	53.9	13.1	15.4	87.6	12.4	0.5	85.9
4	21.05	4.52	4.65	0.50	326.3	254.1	72.2	56.7	13.2	15.5	89.7	10.3	0.2	86.3
5	24.67	5.14	4.80	0.36	265.2	213.6	51.6	40.8	9.2	10.8	83.1	16.9	0.4	69.7
6	18.08	4.18	4.32	0.50	277.9	211.4	66.5	51.2	13.0	15.3	94.6	5.4	0.7	84.2

DEVON BUTTER RECORD — MONTHLY AVERAGES OF IONE.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of fat containing 85 per cent. butter-fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees	Hrs.	Min.									
1*	March, 1891	38	63	....	28	18.31	3.84	0.25	3.59	0.0	3.57	4.20	81	517
2	April, 1891	44	64	....	35	20.17	4.04	0.57	3.47	0.01	3.42	4.02	88	489
3	May, 1891	48	64	....	36	19.48	3.93	0.57	3.36	0.02	3.21	3.78	78	520
4	June, 1891	46	67	....	46	16.84	3.89	0.64	3.25	0.01	3.17	3.73	65	571
5	July, 1891	47	65	....	46	18.60	3.92	0.72	3.20	0.03	3.15	3.71	173	210
6	August, 1891	47	68	1	10	17.32	4.53	1.36	3.17	0.01	3.13	3.68	134	346
7	September, 1891	47	68	....	53	16.68	4.93	1.21	3.72	0.04	3.25	3.83	186	270
8	October, 1891	46	68	1	31	17.44	4.44	1.04	3.40	0.02	3.38	3.98	241	200
9	November, 1891	....	69	....	55	23.14	5.57	0.11	5.46	0.09	4.88	5.74	225	250

* First month of lactation contains twenty-four days.

DEVON BUTTER RECORD — MONTHLY AVERAGES OF IONE — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1	23.83	5.10	4.67	0.54	253.0	203.4	49.6	39.0	9.0	10.6	93.4	6.6	0.4	92.9
2	24.87	5.81	4.28	0.58	432.9	358.4	74 5	57.1	14.8	17.4	85.9	14.1	0.3	84.7
3	26.47	5.78	4.58	0.58	473.7	391.8	81.9	64.0	15.2	17.9	85.6	14.4	0.4	81.8
4	26.85	5.17	5.19	0.58	471.3	380.2	91.1	73.5	15.0	17.6	83.6	16.4	0.3	81.6
5	26.97	5.81	4.64	0.55	460.4	381.2	79.2	62.1	14.5	17.1	81.5	18.5	0.9	79.1
6	27.20	5.46	4.98	0.47	392.4	320.5	71.9	57.5	12.2	14.4	70.5	29.5	0.2	69.7
7	26.12	4.48	5.83	0.41	323.5	251.3	72.2	59.8	10.5	12.4	75.3	24.7	0.8	66.0
8	25.13	5.13	4.90	0.45	346.0	278.6	67.4	53.6	11.7	13.8	76.6	23.4	0.5	76.0
9	17.42	4.23	4.12	0.60	311.9	238.2	73.7	55.8	15.2	17.9	98.0	20.0	1.6	87.6

GUERNSEY BUTTER RECORD—MONTHLY AVERAGES OF ORIOLE.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.				FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.	Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs. Min.									
1	December, 1890	41	60	 20	21.51	6.87	0.12	6.75	0.08	6.57	7.72	......	......
2	January, 1891	39	61	 17	16.82	4.94	0.11	4.83	0.03	4.69	5.52	45	980
3	February, 1891	39	62	 18	15 41	4.49	0.16	4.33	0.03	4.25	5.13	64	715
4	March, 1891	37	61	 47	13.88	4.36	0.11	4.25	0.02	4.21	4 96	79	596
5	April, 1891	44	63	 25	18.43	4.89	0.18	4.71	0.02	4.46	5.24	61	805
6	May, 1891	48	63	 41	17.42	4.83	0.23	4.60	0.02	4.43	5.21	65	760
7	June, 1891	47	65	 25	17.81	4.85	0.28	4.57	0.05	4.48	5.27	53	830
8	July, 1891	46	65	 42	15.54	4.95	0.33	4.62	0.03	4.57	5.37	84	618
9	August, 1891	47	66	 25	16.85	5.11	0.19	4.92	0.03	4.88	5.74	86	535
10	September, 1891	47	70	 15	14.78	5.29	0.58	4.71	0.17	4.54	5.34	93	575
11	October, 1891	....	68	 52	25.31	5.55	0.08	5.47	0.40	5.07	5.96	110	615
12	November, 1891	....	70	 30	25.22	5.35	0.08	5.27	0.33	4.94	5.81	119	517

GUERNSEY BUTTER RECORD — MONTHLY AVERAGES OF ORIOLE — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	13.09	3.18	4.12	1.05	305.4	209.4	96.0	72.7	19.8	23.3	98.3	1.7	1.2	95.4
2	18.24	3.50	5.21	0.78	440.0	314.3	125.7	101.6	20.5	24.1	97.8	2.2	0.6	95.1
3	19.50	3.52	5.54	0.88	478.4	342.5	135.9	111.4	20.8	24.5	96.3	3.7	0.6	95.5
4	20.21	3.25	6.22	0.86	536.3	371.3	165.0	138.5	22.5	26.5	97.4	2.6	0.5	96.5
5	19.08	3.90	4.89	0.97	557.3	414.3	143.0	113.8	24.8	29.2	96.3	3.7	0.4	91.1
6	19.27	3.79	5.08	0.98	581.3	427.9	153.4	123.2	25.7	30 2	95.2	4.8	0.4	91.5
7	19.08	3.91	4.88	0.97	558.2	415.5	142.7	113.4	24.9	29.3	94.2	5.8	1.0	92.3
8	18.60	3.38	5.50	1.00	577.9	407.0	170.9	139.8	26.4	31.1	93.5	6.5	0.6	92.5
9	17.75	3.42	5.19	1 02	560.6	396.7	163.9	132.3	26.9	31.6	96.4	3.6	0.6	95.0
10	18.73	3.14	5.96	0.84	475.3	324.0	151.3	125.9	21.6	25.4	89.2	10.8	3.2	85.9
11	16.78	4.63	3.62	1.00	521.8	409.1	112.7	81.6	26.4	31.1	98.6	1.4	7.2	91.4
12	17.21	4.80	3.60	0.96	495.5	392.3	103.2	74.4	24.5	28.8	98.5	1.5	6.1	92.3

* First month of lactation contains twenty-four days.

GUERNSEY BUTTER RECORD — MONTHLY AVERAGES OF ROSETTE FORD.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees	Degrees.	Hrs.	Min.									
1	November, 1890	47	61	....	14	21.32	5.40	0.19	5.21	0.26	4.92	5.80	61	928
2	December, 1890	41	60	....	20	19.45	5.32	0.26	5.06	0.06	4.82	5.67	46	1147
3	January, 1891	42	62	....	46	17.81	4.74	0.33	4.41	0.03	4.22	4.96	39	1193
4	February, 1891	38	65	....	25	15.82	4.90	0.28	4.62	0.02	4.52	5.32	72	722
5	March, 1891	37	61	....	42	19.01	5.12	0.22	4.90	0.02	4.86	5.72	66	870
6	April, 1891	43	61	....	47	20.06	5.02	0.50	4.52	0.02	4.40	5.18	75	714
7	May, 1891	44	64	....	38	16.25	4.81	0.65	4.16	0.02	3.98	4.68	152	338
8	June, 1891	45	65	....	42	16.82	4.76	0.41	4.35	0.03	4.29	5.04	93	517
9	July, 1891	47	65	....	27	15.47	4.73	0.49	4.24	0.07	4.16	4.89	165	281
10	August, 1891	47	68	....	40	17.42	4.98	0.79	4.19	0 03	4.16	4.89	115	278
11	September, 1891	47	67	....	30	21.82	5.71	0.42	5.29	0.04	4.47	5.26	162	441
12	October, 1891	....	70	....	22	19.66	5.92	0.52	5.40	0.12	5.27	6.20	116	582
13	November, 1891	....	68	....	45	27.04	6.11	0.08	6.03	0.31	5.62	6.61	146	444

GUERNSEY BUTTER RECORD — MONTHLY AVERAGES OF ROSETTE FORD — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	17.85	4.10	4.35	0.73	195.4	147.8	47.6	36.7	9.3	10.9	96.3	3.7	1.4	90.6
2	17.72	3.81	4.65	0.98	543.4	400.4	143.0	112.3	26.1	30.7	95.2	4.8	1.0	90.8
3	20.13	4.00	5.03	0.90	561.5	421.1	140.4	112.5	23.7	27.9	93.0	7.0	0.5	89.0
4	18.80	3.42	5.50	0.91	482.3	341.3	141.0	115.3	21.8	25.7	94.3	5.7	0.4	92.2
5	17.41	3.85	4.52	0.91	501.9	371.5	130.4	101.5	24.6	28.9	95.8	4.2	0.4	94.9
6	19.31	4.46	4.33	0.83	478.8	371.4	107.4	82.6	21.1	24.8	90.0	10.0	0.3	87.6
7	21.39	3.90	5.48	0.78	515.9	383.6	132.3	108.2	20.5	24.1	86.5	13.5	0.4	82.9
8	19.84	3.88	5.12	0.80	476.1	353.4	122.7	98.7	20.4	24.0	91.6	8.4	0.6	90.0
9	20.43	3.65	5.60	0.73	463 7	336.7	127.0	104.3	19.3	22.7	89.7	10.3	1.5	87.9
10	20.45	4.17	4.90	0.71	452.0	343.6	108.4	86.3	18.8	22.1	84.3	15.7	0.6	83.4
11	19.02	4.13	4.61	0.67	380.4	288.3	92.1	72.1	17.0	20.0	92.9	7.1	0.7	78.6
12	16.13	3.64	4.43	0.77	386.9	280.6	106.3	82.3	20.4	24.0	91.2	8.8	2.0	89.0
13	15.13	4.48	3.38	0.77	347.3	269.5	77.8	54.8	19.6	23.0	98.7	1.3	5.1	92.0

* First month of lactation contains fifteen days.

AMERICAN HOLDERNESS BUTTER RECORD — MONTHLY AVERAGES OF NELLIE 6TH.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in butter-milk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees	Degrees	Hrs.	Min.									
1	September, 1890	45	61	....	47	23.14	4.78	0.67	4.11	0.12	3.78	4.44	......	......
2	October, 1890	48	61	....	55	20.96	3.54	0.48	3.06	0.04	2.85	3.38	79	609
3	November, 1890	49	60	....	51	18.44	3.36	0.44	2.92	0.05	2.67	3.14	......	......
4	December, 1890	41	64	1	19	14.94	3.25	0.36	2.89	0.04	2.81	3.30	109	407
5	January, 1891	38	66	1	7	15.82	3.30	0.44	2.85	0.02	2.76	3.25	83	279
6	February, 1891	38	67	1	0	15.75	3.48	0.33	3.15	0.04	3.10	3.66	103	339
7	March, 1891	38	66	2	11	15.05	3.28	0.28	3.00	0.02	2.95	3.47	114	282
8	April, 1891	43	61	1	15	16.39	3.52	0.55	2.97	0.01	2.88	3.38	99	381
9	May, 1891	45	65	1	2	17.68	3.56	0.63	2.93	0.02	2.87	3.38	119	285
10	June, 1891	45	67	1	16	11.58	3.26	0.54	2.72	0.05	2.31	2.72	119	269

AMERICAN HOLDERNESS BUTTER RECORD — MONTHLY AVERAGES OF NELLIE 6TH — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	22.44	5.62	4.00	0.59	240.3	197.6	42.8	32.1	9.1	10.7	86.6	13.4	2.6	79.7
2	30.07	6.76	4.45	0.55	513.9	437.9	76.0	59.0	14.5	17.0	86.5	13.5	1.1	80.7
3	31.96	6.29	5.08	0.55	531.9	447.4	84.5	67.9	14.1	16.6	87.0	13.0	1.6	79.3
4	30.42	5.18	5.87	0.48	455.4	367.5	87.9	72.9	12.8	15.0	88.9	11.2	1.1	86.5
5	30.72	5.53	5.55	0.50	474.6	390.3	84.2	68.8	13.1	15.4	89.6	13.4	0.8	83.9
6	27.32	5.00	5.46	0.55	420.1	336.1	84.0	68.6	13.1	15.4	90.5	9.5	1.1	89.3
7	28.90	5.00	5.78	0.45	400.6	320.5	80.1	66.3	11.7	13.8	91.5	8.5	0.7	89.9
8	29.64	5.50	5.39	0.41	364.2	298.0	66.2	53.9	10.5	12.3	84.2	15.8	0.4	81.7
9	29.62	6.02	4.92	0.42	387.4	323.1	64.3	51.2	11.1	13.1	82.5	17.5	0.4	80.7
10	36.76	4.24	8.67	0.17	183.1	140.0	43.1	38.1	4.3	5.0	83.4	16.6	1.5	70.9

* First month of lactation contains eighteen days.

AMERICAN HOLDERNESS BUTTER RECORD — MONTHLY AVERAGES OF MAGGIE 6TH.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs.	Min.									
1	September, 1890	42	59	1	25	23.31	5.30	0.59	4.71	0.09	4.51	5.31	......	....
2	October, 1890	48	60	....	51	20.61	3.68	0.37	3.31	0.05	3.09	3.64	55	713
3	November, 1890	48	60	....	47	19.54	3.38	0.33	3.05	0.08	2.87	3.38	68	607
4	December, 1890	42	59	1	13	17.63	3.63	0.49	3.14	0.03	3.06	3.60	65	594
5	January, 1891	44	64	1	42	14.60	3.36	0.41	2.95	0.02	2.87	3.37	75	514
6	February, 1891	38	64	1	51	11.83	3.18	0.40	2.78	0.06	2.70	3.17	104	308
7	March, 1891	38	66	1	14	15.54	3.41	0.38	3.03	0.06	2.98	3.51	107	376
8	April, 1891	44	64	1	8	20.66	3.46	0.33	3.13	0.02	3.00	3.53	89	376
9	May, 1891	45	66	...	50	17.63	3.62	0.49	3.13	0.04	3.07	3.61	112	344
10	June, 1891	46	67	1	30	17.58	3.62	0.28	3.34	0.11	2.96	3.48	93	403
11	July, 1891	46	69	1	32	17.95	3.31	0.33	2.98	0.06	2.91	3.43	146	235
12	August, 1891	47	69	....	45	16.15	3.45	0.42	3.03	0.13	2.78	3.27	160	246
13	September, 1891	47	67	....	45	17.28	3.78	0.67	3.11	0.06	2.96	3.48	164	286
14	October, 1891	....	67	1	12	20.22	3.72	0.12	3.60	0.30	3.21	3.78	147	263
15	November, 1891	....	72	....	55	11.98	3.15	0.07	3.08	0.08	3.00	3.53	212	113

American Holderness Butter Record—Monthly Averages of Maggie 6th—(*Concluded*).

Month of lactation.	Yield of Butter.				Monthly Yield of Dairy Products.						Percentages of Fat Recovered and Lost.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	18.83	4.95	3.80	0.54	61.2	48.8	12.4	9.1	2.8	3.3	88.9	11.1	1.7	85.1
2	27.97	6.21	4.50	0.65	568.5	477.0	91.5	71.2	17.3	20.3	89.8	10.2	1.4	83.9
3	29.76	6.41	4.64	0.65	585.3	494.0	91.3	71.7	16.8	19.6	90.0	10.0	2.5	84.9
4	27.91	5.58	5.00	0.61	522.9	429.3	93.7	75.0	15.6	18.7	85.5	13.5	0.9	84.3
5	29.75	4.98	5.97	0.53	493.2	394.2	99.0	82.4	14.1	16.6	87.8	12.2	0.5	85.5
6	31.55	4.25	7.42	0.47	413.0	315.9	97.1	84.0	11.1	13.1	87.3	12.7	1.9	84.9
7	28.49	5.13	5.38	0.53	449.4	361.8	87.6	71.3	13.9	16.3	88.9	11.1	1.6	87.4
8	28.33	6.62	4.28	0.49	417.1	354.1	63.0	48.3	12.5	14.7	90.6	9.4	0.4	86.7
9	27.71	5.65	4.90	0.50	428.1	352.3	75.8	60.3	13.2	15.5	86.5	13.5	1.1	85.0
10	28.75	5.26	5.46	0.47	407.6	330.1	77.5	63.4	12.0	14.1	92.3	7.7	3.0	81.8
11	29.19	6.02	4.85	0.46	416.9	347.7	69.2	54.9	12.2	14.3	90.0	10.0	1.8	88.0
12	30.69	5.35	5.73	0.41	391.8	318.6	73.2	60.5	10.8	12.7	87.9	12.1	1.5	80.6
13	28.81	5.56	5.18	0.37	318.2	261.0	57.2	46.2	9.4	11.0	82.1	17.9	1.6	78.3
14	26.45	5.62	4.71	0.39	320.1	263.1	57.0	44.9	10.3	12.1	96.8	3.2	8.0	86.3
15	28.33	3.89	7.28	0.32	267.7	198.9	68.8	59.4	8.0	9.4	97.8	2.2	2.5	95.2

* First month of lactation contains six days.

HOLSTEIN-FRIESIAN BUTTER RECORD.— MONTHLY AVERAGES OF ESEL 2D.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs.	Min.									
2	August, 1890	48	60	....	40	22.14	3.59	0.58	3.01	0.40	2.33	2.74	53	640
3	September, 1890	47	61	1	7	20.02	3.86	0.78	3.08	0.17	2.77	3.26	67	576
4	October, 1890	49	62	1	31	19.99	3.64	0.57	3.07	0.21	2.43	2.86	132	256
5	November, 1890	48	60	1	15	20.40	3.66	1.06	2.60	0.11	2.43	2.86	95	396
6	December, 1890	42	63	2	17	17.74	3.92	0.52	3.40	0.07	3.27	3.85	66	595
7	January, 1891	39	63	1	40	19.48	3.55	0.53	3.02	0.03	2.91	3 42	94	340
8	February, 1891	38	64	1	27	19.49	3.73	0.60	3.13	0 03	3.07	3.62	123	310
9	March, 1891	37	65	2	14	20.47	3.90	0.41	3.49	0.01	3.35	3.94	132	384
10	April, 1891	44	72	5	58	19.13	3.95	1.22	2.73	0.05	2.60	3.06	168	248
11	May, 1891	48	67	3	11	17.00	3.72	0.96	2.76	0.03	2.62	3.09	166	239
12	June, 1891	47	68	....	38	18.71	3.45	0.54	2.91	0.16	2.39	2.81	120	300
13	July, 1891	46	66	1	2	14.07	2.98	0.70	2.28	0.11	2.06	2.42	150	197
14	August, 1891	48	67	....	49	14.03	2.92	0.76	2.16	0.09	2.00	2.35	149	215
15	September, 1891	48	71	....	30	23.08	3.87	1.03	2.84	0.08	1.68	1.97	173	254
16	Oct. ber, 1891	....	72	2	12	13.31	3.30	0.08	3.22	0 29	2.90	3.41	233	147
17	November, 1891	....	71	2	11	16.20	3.11	0.08	3.03	0.19	2.64	3.11	194	174

HOLSTEIN-FRIESIAN BUTTER RECORD — MONTHLY AVERAGES OF ESEL 2D — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
2	36.50	7.36	4.97	0.78	884.0	764.0	120.0	95.8	20.6	24.2	83.8	16.2	11.2	64.8
3	30.69	6.47	4.76	0.97	895.0	756.7	138.3	109.3	24.7	29.0	79.9	20.1	3.2	71.7
4	34.96	6.49	5.51	0.68	780.6	660.3	120.3	98.5	18.5	21.8	84.4	15.6	7.0	66.9
5	34.96	7.87	4.50	0.71	750.5	655.1	95.4	74.2	18.0	21.2	71.0	29.0	3.1	66.2
6	25.97	5.21	4.98	0.90	725.1	586.0	139.1	111.5	23.5	27.6	86.7	13.3	1.9	83.5
7	29.21	6.41	4.56	0.87	790.1	666.9	123.2	96.2	23.0	27.0	85.5	14.5	0.8	82.5
8	27.61	6.21	4.45	0.85	655.8	550.2	105.6	81.9	20.1	23.7	84.0	16.0	0.9	82.4
9	25.40	5.85	4.37	0.81	638.1	529.0	109.1	84.1	21.2	25.0	89.2	10.8	0.3	85.6
10	32.68	7.00	4.69	0.56	544.7	467.1	77.6	61.0	14.1	16.6	69.0	31.0	3.0	65.7
11	32.36	6.10	5.30	0.56	560.6	468.7	91.9	74.6	14.7	17.3	74.3	25.7	0.8	70.7
12	35.42	6.45	5.54	0.64	683.0	577.2	105.8	86.5	16.4	19.3	84.1	15.9	4.7	69.3
13	41.38	6.17	6.71	0.58	741.6	621.4	120.2	102.3	15.2	17.9	76.1	23.9	3.8	69.1
14	43.38	6.50	6.67	0.49	662.0	560.2	101.8	86.5	13.0	15.3	75.2	24.8	3.0	69.9
15	51.08	8.13	6.28	0.40	612.9	537.5	75.4	63.4	10.2	12.0	73.2	26.8	2.3	43.4
16	29.50	4.13	7.14	0.67	617.2	467.8	149.4	128.5	17.8	20.9	97.7	2.3	8.9	87.8
17	32.15	5.35	6.01	0.59	563.8	458.4	105.4	87.8	15.0	17.6	97.4	2.6	6.1	84.9

HOLSTEIN-FRIESIAN BUTTER RECORD — MONTHLY AVERAGES OF TOLSMA ARTIS.*

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.				FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.	Per cent. of fat in in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs. Min.									
4	August, 1890	51	60	 31	23.59	3.63	0.90	2.73	0.13	2.18	2.56	93	314
5	September, 1890	51	60	 44	18.82	3.15	1.83	1.32	0.14	1.01	1.19	50	644
6	October, 1890	49	60	 57	19.85	3.19	0.87	2.32	0.11	2.07	2.43	......	....
7	November, 1890	48	61	 32	19.86	4.80	0.46	4.34	0.04	3.14	3.69	100	509
8	December, 1890	42	62	1 2	15.88	3.71	0.43	3.28	0.04	3.11	3.65	112	344
9	January, 1891	39	67	1 44	12.49	3.50	0.65	2.85	0.02	2.76	3.24	104	289
10	February, 1891	38	65	2 15	7.78	3.35	0.46	2.89	0.10	2.78	3.27	182	186

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* First period of lactation, Tolsma Artis was in an abnormal condition much of the time, and the results are, therefore, excluded from the averages for the herd.

HOLSTEIN-FRIESIAN BUTTER RECORD—MONTHLY AVERAGES OF TOLMA ARTIS.*—(*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAILY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
4	46.39	8.95	5.18	0.59	841.8	747.8	9.4	75.9	15.4	18.1	72.5	27.5	3.9	57.5
5	84.41	14.30	5.90	0.29	727.3	676.4	50.9	42.3	7.3	8.6	41.7	58.3	4.5	31.2
6	41.81	8.33	5.02	0.34	447.7	394.0	53.7	43.0	9.1	10.7	72.6	27.4	3.6	64.6
7	27.06	4.56	5.93	0.30	241.8	188.8	53.0	44.0	7.7	9.0	90.5	9.5	9.5	65.5
8	27.38	4.74	5.77	0.36	309.7	244.4	65.3	54.0	9.6	11.3	88.5	11.5	1.2	83.8
9	30.82	4.46	6.91	0.25	237.2	184.0	53.2	45.5	6.5	7.7	81.4	11.6	0.6	78.9
10	30.58	2.70	11.30	0.10	80.7	50.8	19.0	27.3	2.2	2.6	86.3	13.7	3.0	83.0

* First period of lactation.

HOLSTEIN-FRIESIAN BUTTER RECORD—MONTHLY AVERAGES OF TOLSMA ARTIS.*

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs.	Min.									
1	June, 1891	46	64	....	29	13.95	2.55	0.15	2.40	0.05	2.36	2.77	71	404
2	July, 1891	47	66	....	38	13.68	2.33	0.21	2.12	0.05	1.97	2.32	107	235
3	August, 1891	47	68	....	32	11.91	2.12	0.75	1.37	0.01	1.36	1.60	122	206
4	September, 1891	47	67	....	33	15.12	2.77	0.82	1.95	0.01	1.63	1.92	105	293
5	October, 1891	....	70	....	30	14.97	2.92	0.21	2.71	0.07	2.73	3.10	145	221
6	November, 1891	....	68	....	35	15.32	2.90	0.08	2.82	0.05	2.77	3.26	188	191

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* Second period of lactation.

AMERICAN HOLDERNESS BUTTER RECORD — MONTHLY AVERAGES OF TOLSMA ARTIS* — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1	36.48	5.81	6.28	0.82	895.8	741.6	154.2	129.6	20.9	24.6	94.1	5.9	1.9	92.3
2	43.22	6.45	6.70	0.72	966.5	816.7	149.8	127.5	19.0	22.3	90.8	9.2	2.0	84.6
3	64.30	8.69	7.40	0.44	880.5	779.2	101.3	87.6	11.6	13.7	64.2	35.8	0.5	63.6
4	52.08	7.75	6.72	0.46	723.4	630.1	93.3	79.4	11.8	13.9	70.8	29.2	0.4	58.9
5	33.23	5.53	6.00	0.74	765.8	627.3	138.5	115.5	19.6	23.0	92.1	7.9	2.4	89.7
6	30.67	5.43	5.65	0.80	736.6	601.0	135.6	111.6	20.4	24.0	97.2	2.8	1.7	95.5

* Second period of lactation.

JERSEY BUTTER RECORD — MONTHLY AVERAGES OF BARBARA ALLEN.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs.	Min.									
2	September, 1890	47	61	1	7	18.91	4.91	0.51	4.40	0.11	4.14	4.87	......	......
3	October, 1890	49	62	....	47	20.90	5.16	0.29	4.87	0.10	4.52	5.31	42	1216
4	November, 1890	48	61	....	40	21.08	5.33	0.18	5.15	0.04	4.48	5.27	123	984
5	December, 1890	41	63	....	35	18.43	5.55	0.24	5.31	0.02	5.17	6.08	61	1256
6	January, 1891	39	63	....	27	14.42	5.70	0.31	5.39	0.05	5.18	6.09	49	1127
7	February, 1891	38	65	....	33	17.63	5.48	0.38	5.10	0 04	5.02	5.91	54	1011
8	March, 1891	37	65	....	51	16.25	5.38	0.17	5.21	0.02	5.13	6.03	85	603
9	April, 1892	43	61	....	58	23.85	5.46	0.25	5.21	0.02	5.08	5.98	80	728
10	May, 1892	44	64	....	47	19.53	5.33	0.46	4.87	0.02	4.74	5.57	103	542
11	June, 1891	45	66	....	37	15.06	4.90	0.14	4.76	0.04	4.66	5.48	81	610
12	July, 1891	47	64	....	32	19.37	5.15	0.19	4.96	0.11	4.83	5.68	115	445
13	August, 1891	47	68	....	37	17.20	5.16	0.23	4.93	0.02	4.91	5.77	81	599
14	September, 1891	47	66	....	42	17.47	5.57	0.33	5.24	0.03	5.18	6.09	118	471
15	October, 1891	....	70	....	20	19.31	5.41	0.21	5.20	0.09	5.11	6.01	154	358
16	November, 1891	....	69	....	55	28.02	6.16	0.08	6.08	0.22	5.87	6.91	253	301

JERSEY BUTTER RECORD—MONTHLY AVERAGES OF BARBARA ALLEN—(*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
2	20.67	4.37	4.73	0.84	519.0	400.0	119.0	93.9	21.3	25.1	89.7	10.3	2.3	84.5
3	18.96	4.13	4.59	0.85	501.7	380.2	121.5	95.0	22.5	26.5	94.3	5.7	2.0	87.5
4	19.05	4.09	4.66	0.87	494.2	373.2	121.0	95.1	22.0	25.9	96.6	3.4	0.8	84.0
5	16.49	3.45	4.79	0.88	450.6	319.6	131.0	103.7	23.2	27.3	95.7	4.3	0.4	93.3
6	16.41	2.67	6.15	0.98	495.2	309.8	185.4	155.2	25.7	30.2	94.6	5.4	0.9	91.0
7	16.94	3.43	4.94	0.86	409.9	290.4	119.5	95.3	20.6	24.2	93.0	7.0	0.4	91.6
8	16.63	3.13	5.31	0.85	437.4	298.0	139.4	113.1	22.4	26.3	96.8	3.2	0.4	95.2
9	16.74	4.60	3.64	0.83	418.1	327.2	90.9	66.0	21.2	24.9	96.5	4.5	0.3	93.1
10	17.98	4.00	4.49	0.76	421.7	316.3	105.4	81.9	20.0	23.5	91.4	8.6	0.4	88.8
11	18.26	3.16	5.78	0.85	468.3	320.1	148.2	122.6	21.8	25.6	97.2	2.8	0.5	96.2
12	17.66	3.90	4.53	0.86	471.7	350.7	121.0	94.3	22.7	26.7	96.4	3.6	2.2	93.8
13	17.40	3.50	4.97	0.82	444.0	317.0	127.0	101.5	21.7	25.5	95.5	4.5	0.4	95.0
14	16.43	3.33	4.90	0.68	337.1	235.9	101.2	80.7	17.4	20.5	94.1	5.9	0.4	92.9
15	16.64	3.71	4.48	0.71	367.4	268.4	99.0	76.9	18.8	22.1	96.1	3.8	1.6	94.5
16	14.47	4.61	3.14	0.79	340.7	266.8	73.9	50.4	20.0	23.5	98.7	1.3	3.5	95.2

JERSEY BUTTER RECORD—MONTHLY AVERAGES OF GILDERBLOOM.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.				FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churniug.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees	Degrees	Hrs.	Min.									
1	September, 1890	46	61	....	33	24.17	6.10	0.44	5.66	0.15	5.23	6.15	49	1104
2	October, 1890	48	61	....	25	21.21	5.62	0.28	5.34	0.08	4.99	5.87	53	1098
3	November, 1890	48	62	....	28	21.49	5.19	0.20	4.99	0.06	4.60	5.41	48	1239
4	December, 1890	42	59	1	5	21.96	6.16	0.31	5.85	0.04	5.74	6.75	48	1209
5	January, 1891	44	61	....	53	17.77	5.47	0.30	5.17	0.02	5.11	6.01	48	1208
6	February, 1891	38	62	....	52	14.85	5.37	0.29	5.08	0.09	4.97	5.84	82	687
7	March, 1891	38	65	1	47	18.90	5.68	0.19	5.49	0.02	5.34	6.28	81	766
8	April, 1891	44	64	....	37	21.60	5.61	0.20	5.41	0.02	5.37	6.32	70	834
9	May, 1891	45	65	....	30	18.39	5.63	0.38	5.25	0.02	4.98	5.85	88	637
10	June, 1891	46	65	....	42	18.59	5.65	0.24	5.40	0.04	5.36	6.30	107	467
11	July, 1891	46	66	....	42	15.94	4.91	0.51	4.40	0.03	4.35	5.11	120	414
12	August, 1891	47	67	....	42	17.29	4.97	0.36	4.61	0.03	4.58	5.39	161	329
13	September, 1891	47	70	....	34	13.95	5.41	0.46	4.95	0.25	4.69	5.52	144	378

JERSEY BUTTER RECORD — MONTHLY AVERAGES OF GILDERBLOOM — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1*	16.30	4.19	3.89	0.99	341.1	259.7	81.4	60.5	17.8	20.9*	92.7	7.3	2.5	85.7
2	17.09	3.96	4.32	1.01	535.6	400.4	135.2	103.9	26.6	31.3	95.0	5.0	1.4	88.9
3	18.50	4.31	4.29	0.85	473.8	363.9	109.9	84.3	21.8	25.6	95.9	4.1	1.1	88.8
4	14.83	3.76	3.93	0.89	410.7	301.4	109.3	79.6	23.5	27.7	94.9	5.1	0.7	93.2
5	16.66	3.42	4.88	0.83	428.4	303.1	125.3	99.8	21.7	25.5	94.4	5.6	0.4	93.3
6	17.17	2.98	5.77	0.72	343.2	225.7	117.5	97.5	17.0	20.0	94.5	5.5	1.6	92.4
7	16.00	3.45	4.90	0.73	342.0	242.9	99.1	78.9	17.2	20.2	96.7	3.3	0.4	94.4
8	15.83	4.00	3.95	0.65	307.1	230.3	86.8	57.4	16.5	19.4	96.5	2.5	0.4	95.8
9	17.10	3.50	4.88	0.67	356.8	254.8	102.0	81.1	27.8	29.9	93.2	6.8	0.4	88.4
10	15.86	3.45	4.60	0.66	315.5	224.1	91.4	71.5	16.9	19.9	95.8	4.2	0.7	94.9
11	19.91	3.62	5.50	0.49	301.0	217.9	83.1	68.0	12.8	15.1	90.0	10.0	0.7	89.0
12	18.55	3.76	4.93	0.44	255.5	187.5	68.0	54.2	11.7	13.8	92.8	7.2	0.6	92.1
13	18.24	2.83	6.44	0.37	204.5	132.2	72.3	61.1	9.5	11.2	91.5	8.5	4.8	86.7

* First month of lactation contains twenty-one days.

JERSEY BUTTER RECORD — MONTHLY AVERAGES OF COUNTESS FLAVIA.

MONTH OF LACTATION.	Date.	CREAMING AND CHURNING.					FROM 100 POUNDS OF MILK.						MICROSCOPIC DATA.	
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Relative number of fat globules.	Relative size of fat globules.
		Degrees.	Degrees.	Hrs.	Min.									
5	August, 1890	51	60	1	40	26.32	6.01	0.68	5.33	0.09	5.10	6.00	58	984
6	September, 1890	51	62	2	15	26.23	6.12	0.95	5.17	0.20	4.56	5.37	96	724
7	October, 1890	49	63	2	15	22.58	5.99	0.35	5.64	0.05	5.22	6.14	52	1273
8	November, 1890	49	64	1	23	24.65	6.42	0.49	5.93	0.07	5.69	6.69	85	759
9	December, 1890	42	63	1	17	20.88	6.18	0.51	5.67	0.02	5.45	6.42	80	780
10	January, 1891	39	66	1	11	18.23	6.45	0.52	5.93	0.02	5.84	6.86	99	703
11	February, 1891	38	63	....	50	17.99	6.35	0.40	5.95	0.03	5.89	6.93	78	757
12	March, 1891	38	65	1	3	20.68	6.56	0.19	6.37	0.03	5.87	6.90	63	1040
13	April, 1891	43	65	....	57	20.94	6.30	0.19	6.11	0.02	5.86	6.89	69	939
14	May, 1891	46	66	....	51	20.86	5.87	0.49	5.38	0.04	5.27	6.20	70	908
15	June, 1891	46	65	....	33	18.50	5.86	0.20	5.66	0.02	5.31	6.25	60	909
16	July, 1891	47	65	....	32	18.15	5.88	0.17	5.71	0.05	5.66	6.66	111	508
17	August, 1891	47	68	1	13	21.84	6.32	0.37	5.95	0.05	5.90	6.94	110	612
18	September, 1891	47	67	....	33	18.59	8.07	0.66	7.41	0.02	7.38	8.68	258	316

Jersey Butter Record — Monthly Averages of Countess Flavia — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter milk.	Per cent. of fat recovered in butter.
5	16.65	4.94	3.37	1.11	574.0	457.8	116.2	81.8	29.2	34.4	88.7	11.3	1.5	84.9
6	18.77	5.13	3.66	0.87	492.4	396.4	96.0	69.8	22.2	26.2	84.5	15.5	3.3	74.5
7	16.43	4.00	4.11	0.93	474.1	355.6	118.5	89.7	24.5	28.8	94.1	5.9	0.8	86.9
8	14.94	4.17	3.58	0.99	442.7	336.6	106.1	76.5	25.2	29.6	92.4	7.6	1.1	88.6
9	15.64	3.68	4.25	0.93	448.9	326.9	122.0	93.3	24.4	28.7	91.8	8.2	0.3	85.0
10	14.62	3.07	4.76	0.99	449.8	303.3	146.5	115.7	26.2	30.8	91.9	8.1	0.3	90.6
11	14.43	3.03	4.76	0.91	365.8	245.1	120.7	95.4	21.5	25.3	93.8	6.2	0.5	92.9
12	14.48	3.25	4.46	0.91	409.8	283.7	126.1	97.8	24.1	28.3	97.1	2.9	0.5	89.5
13	14.51	3.42	4.24	0.94	409.6	289.8	119.8	91.6	24.0	28.2	97.0	3.0	0.3	93.0
14	16.19	3.85	4.21	0.86	432.8	320.4	112.4	85.7	22.7	26.7	91.7	8.3	0.7	89.8
15	16.04	3.27	4.90	0.84	406.2	282.0	124.2	98.9	21.5	25.3	96.5	3.5	0.3	90.8
16	15.03	3.18	4.73	0.88	408.1	279.8	128.3	101.2	23.0	27.1	97.1	2.9	0.8	96.2
17	14.42	3.68	3.92	0.85	377.9	275.2	102.7	76.5	22.3	26.2	94.4	5.6	0.8	93.5
18	11.51	2.51	4.58	0.76	261.9	157.6	104.3	81.5	19.4	22.8	91.9	8.1	0.2	91.4

XV. COMPARISON OF DAIRY BREEDS OF CATTLE WITH REFERENCE TO PRODUCTION OF CHEESE.

The results of our investigation of cheese appear to indicate that the yield of cheese from a given amount of milk depends, when the conditions of manufacture are fairly uniform, upon the following factors:

1st. The amount of fat in the milk.

2d. The amount of casein and albumen in the milk.

3d. The amount of fat *relative* to the amount of casein and albumen.

The indications are that, when we shall have continued our experiments on a more extensive plan, we shall, in all probability, be able to calculate very closely from the composition of the milk the amount of cheese that can be made from a given quantity of it; and possibly we may be able to do this accurately enough for all commercial purposes from knowing only the amount of fat contained in the milk.

Basing our calculations upon the results already secured, we will apply them to estimating the amount of cheese that could be made from the milk of the different breeds under investigation. For this purpose, we assume the following as a basis for calculating the cheese-producing power or efficiency of the different kinds of milk:

1. The loss of fat is made seven per cent. of the milk-fat, when the milk contains, on an average, 1.20 pounds of fat or less for one pound of casein and albumen, as in the case of the Ayrshires, Devons, Holderness and Holsteins. The loss of fat is made eight per cent. of the milk-fat, when the milk contains, on an average, 1.40 pounds of fat for one pound of casein and albumen, as in the case of the Guernseys. The loss of fat is made ten per cent. when the milk contains, on an average, 1.50 pounds or more of fat for one pound of casein and albumen, as in the case of the Jerseys.

2. The loss of casein and albumen is made uniformly twenty-three per cent. of the casein and albumen contained in the milk.

3. The other constituents of the cheese, as water, salt and other ash constituents, sugar, lactic acid, etc., are calculated as being four and one-half pounds for the cheese made from 100 pounds of milk.

Below we state, in detail, the data upon which the calculations are based:

AVERAGE PER CENT. OF FAT IN MILK.

(1.) Jerseys	5.68
(2.) Guernseys	5.02
(3.) Devons	4.46
(4.) Holsteins	3.74
(5.) Holderness	3.60
(6.) Ayrshires	3.50

AVERAGE PER CENT. OF CASEIN AND ALBUMEN IN MILK.

(1.) Devons	3.81
(2.) Jerseys	3.76
(3.) Guernsey s	3.60
(4.) Ayershires	3.34
(5.) Holsteins	3.23
(6.) Holderness	3.19

POUNDS OF FAT FOR ONE POUND OF CASEIN AND ALBUMEN IN MILK.

(1.) Jerseys	1.50
(2.) Guernseys	1.40
(3.) Devons	1.17
(4.) Holsteins	1.16
(5.) Holderness	1.13
(6.) Ayrshires	1.05

An examination of the foregoing tables shows the following points of interest:

1. The fat in the milk of the different breeds varies from 5.68 to 3.50 per cent., a variation, between highest and lowest, of 2.18 per cent.

2. The casein and albumen in the milk of the different breeds varied from 3.81 to 3.19 per cent., a variation, between highest and lowest, of 0.62 per cent.

3. The fat varies over three and one-half times as much as the casein and albumen of the milk.

4. If we compare the breeds with reference to per cent. of fat and per cent. of casein and albumen in the milk, we see that the

Devons stand *third* in fat and *first* in regard to casein and albumen; and the Ayrshires, standing *sixth* or lowest in milk-fat, stand *fourth* in regard to casein and albumen. The other breeds preserve the same relative order in regard to casein and albumen as in regard to fat.

5. If we compare the breeds with reference to the milk-fat and the *ratio* of casein and albumen to milk-fat, as in the first and third tables above, we see that they stand in the same relative order; that is, the Jerseys stand highest in regard to milk-fat and their milk also contains the largest amount of fat for each pound of casein and albumen. The other breeds follow in the same relative order in the two tables.

6. The difference in milk-fat, available or recoverable for cheese-making, in 100 pounds of milk, between the highest and lowest is 1.86 pounds, while the difference in regard to casein and albumen, available for cheese-making, between highest and lowest, is 0.48 pounds; that is, the fat that we can fairly expect to work from the milk into the cheese, from 100 pounds of milk, varies nearly four times as much as the casein and albumen, if we consider the variations between the highest and lowest numbers of these constituents, that can be regarded as available for cheese-making.

POUNDS OF CHEESE MADE FROM ONE HUNDRED POUNDS OF MILK.

(1.) Jerseys	12.52
(2.) Guernseys	11.90
(3.) Devons	11.58
(4.) Holsteins	10.55
(5.) Ayrshires	10.33
(6.) Holderness	10.30

POUNDS OF MILK REQUIRED TO MAKE ONE POUND OF CHEESE.

(1.) Jerseys	8.00
(2.) Guernseys	8.40
(3.) Devons	8.64
(4.) Holsteins	9.48
(5.) Ayrshires	9.68
(6.) Holderness	9.72

In examining the two tables preceding, we notice :

1. That the yield of cheese by the different breeds corresponds to the amount of fat in the milk more closely than to the amount of casein and albumen ; that is, the fat in the milk exercises a greater influence on the yield of cheese than do the other constituents of the milk.

2. We notice one exception to the foregoing statement in the case of the Ayrshires and the Holderness. While the milk of the Holderness contains more fat, the yield of cheese from the Ayrshire milk is a trifle greater. This is readily accounted for, when we notice that the amount of casein and albumen in the milk of the Ayrshires is greater than in that of the Holderness.

AVERAGE MONTHLY YIELD OF POUNDS OF CHEESE FOR THE FIRST PERIOD OF LACTATION.

(1.)	Holsteins	78.46
(2.)	Ayrshires	59.77
(3.)	Guernseys	59.60
(4.)	Jerseys	56.14
(5.)	Holderness	46.28
(6.)	Devons	41.32

COST (IN CENTS) OF FOOD CONSUMED FOR EACH POUND OF CHEESE PRODUCED.

(1.)	Guernseys	6.61
(2.)	Holsteins	6.95
(3.)	Ayrshires	7.24
(4.)	Holderness	7.48
(5.)	Jerseys	7.95
(6.)	Devons	8.20

In connection with the preceding table, we notice :

1. That the Guernseys produce a pound of cheese at least food-cost, and this was also true of the butter production of the Guernseys.

2. The Holsteins and Ayrshires, which stood highest in the food-cost of butter production, stand second and third in regard to the food-cost of cheese production ; while the reverse is true of the Jerseys and Devons.

The foregoing tables do not enable us to say which line of production, butter or cheese, would yield the greater profit in case of the different breeds. In order to determine this point more clearly, we present below the total value of the butter produced by each breed during the first period of lactation and also the value of the calculated cheese production. The butter is estimated at twenty-five cents a pound, and the cheese at ten cents a pound, no attempt being made to assign prices varying with the quality of the production of the different breeds.

VALUE OF BUTTER PRODUCTION COMPARED WITH VALUE OF CHEESE PRODUCTION FOR ONE PERIOD OF LACTATION.

	Value of butter production for one period of lactation.		Value of cheese production for one period of lactation.	
Ayrshires	$47 00	(4)	$59 77	(2)
Devons	38 00	(6)	41 32	(6)
Guernseys	67 00	(1)	59 60	(3)
Holderness	39 25	(5)	46 28	(5)
Holsteins	60 25	(3)	78 46	(1)
Jerseys	66 75	(2)	56 14	(4)

PROFITS FROM BUTTER AND CHEESE FOR EACH BREED.

The values below represent the differences between the food cost of the breeds for one period of lactation and the value of the butter and cheese products, as given in the table above.

	Profits from butter for one period of lactation.		Profits from cheese for one period of lactation.	
Ayrshires	$3 70	(6)	$16 47	(3)
Devons	4 30	(5)	7 62	(6)
Guernseys	27 60	(1)	20 20	(2)
Holderness	4 65	(4)	11 68	(4)
Holsteins	5 75	(3)	20 96	(1)
Jerseys	22 15	(2)	11 54	(5)

From the foregoing table it appears that the Guernseys and Jerseys are by far most profitable for butter production, as compared with the other breeds; while for cheese production the Holsteins stand first, with the Guernseys closely following.

GENERAL SUMMARY OF RESULTS RELATING TO THE CHEESE PRODUCTION OF DIFFERENT BREEDS.

The more important results that have been presented in the foregoing discussion are summarized in the table below:

TABULATED SUMMARY OF RESULTS FOR THE FIRST PERIOD OF LACTATION.

	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
Pounds of fat in 100 pounds of milk	3.50	4.46	5.02	3.60	3.74	5.68
Pounds of casein and albumen in 100 pounds of milk	3.34	3.81	3.60	3.19	3.23	3.76
Pounds of fat for one pound of casein and albumen in milk	1.05	1.17	1.40	1.13	1.16	1.50
Pounds of cheese made from 100 pounds of milk	10.33	11.58	11.90	10.30	10.55	12.52
Pounds of milk required to make one pound of cheese	9.68	8.64	8.40	9.72	9.48	8.00
Pounds of cheese produced per month	59.77	41.32	59.60	46.28	78.46	56.14
Food cost for each pound of cheese	0.0724	0.082	0.0661	0.0748	0.0695	0.0795
Value of butter production	$47 00	$38 00	$67 00	$39 25	$60 25	$66 75
Value of cheese production	59 77	41 32	59 60	46 28	78 46	56 14
Profits from butter	3 70	4 30	27 60	4 65	5 75	22 15
Profits from cheese	16 47	7 62	20 20	11 68	20 96	11 54

XVI. THE INFLUENCE OF ADVANCING LACTATION UPON THE PRODUCTION OF BUTTER.

It is proposed to discuss, under the above heading, the influence of advancing lactation upon the various factors that are connected with butter-making, using, as the basis of discussion, the data that have been accumulated in connection with the comparative examination of breeds of dairy cattle.

INFLUENCE OF ADVANCING LACTATION UPON THE AMOUNT OF FAT LOST AND RECOVERED IN BUTTER-MAKING.

In the tables presented below, we have data giving the averages of the different herds of cows for each month during the first period of lactation. The data have already been explained, so far as explanation is needed, under the "comparison of dairy breeds of cattle with reference to butter production."

1. *Pounds of fat in 100 pounds of milk.*

TABLE SHOWING POUNDS OF FAT IN 100 POUNDS OF MILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	3.53	3.54	6.14	5.04	......	6.10
2	3.48	3.73	5.13	3.61	3.59	5.27
3	3.40	3.96	4.61	3.37	3.86	5.18
4	3.40	4.28	4.63	3.44	3.64	5.75
5	3.37	4.43	5.00	3.33	3.66	5.68
6	3.26	5.06	4.93	3.33	3.92	5.73
7	3.48	4.93	4.83	3.35	3.55	5.72
8	3.61	4.44	4.86	3.49	3.73	5.80
9	3.68	5.57	4.92	3.59	3.90	5.76
10	3.83	4.66	5.14	3.44	3.95	5.81

In examining the foregoing table, we notice the following points of interest:

1. In most cases, the per cent. of fat in the milk is greatest during the first month of lactation. The Devons furnish an exception to this general statement, since the per cent. of fat was least in the first month of lactation.

2. In the second month of lactation, the per cent. of fat drops considerably in most cases, the diminution being greatest in the richer milks. In the milks containing the smaller proportions of fat, as the Ayrshires, Holderness and Holsteins, the diminution of per cent. of fat continued until the sixth or seventh month of lactation, while with the Guernseys and Jerseys, the diminution continued through the third month. In the case of the Devons, the per cent. of fat increased gradually from the first month throughout the entire period of lactation, with some fluctuations.

3. The general tendency in regard to the influence of advancing lactation upon the per cent. of fat contained in the milk, is well shown by the following average of all the breeds:

Month of lactation.	Per cent. of fat in milk.
1	4.87
2	4.14
3	4.06
4	4.19
5	4.25
6	4.37
7	4.31
8	4.32
9	4.57
10	4.47

2. *Fat in skim-milk.*

TABLE SHOWING POUNDS OF FAT IN SKIM-MILK FROM 100 POUNDS OF MILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	0.35	0.20	0.16	0.63	......	0.44
2	0.29	0.38	0.18	0.42	0.58	0.40
3	0.42	0.53	0.24	0.38	0.78	0.25
4	0.38	0.55	0.19	0.42	0.57	0.25
5	0.39	0.77	0.20	0.43	1.06	0.41
6	0.52	0.83	0.37	0.36	0.52	0.52
7	0.78	1.21	0.46	0.33	0.53	0.31
8	0.91	1.04	0.37	0.44	0.60	0.29
9	0.67	0.11*	0.34	0.56	0.41	0.39
10	0.82	0.11*	0.69	0.41	1.22	0.41

*Creamed by centrifugal machine.

TABLE SHOWING PER CENT. OF FAT IN MILK LOST IN SKIM-MILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	9.1	5.7	2.7	12.2	......	7.3
2	7.9	10.0	3.5	11.8	16.2	7.6
3	12.1	13.4	5.3	11.5	20.1	4.9
4	11.3	13.3	4.1	12.8	15.6	4.2
5	11.9	17.7	3.9	11.3	29.0	7.1
6	17.3	17.4	7.4	11.1	13.3	8.8
7	22.0	24.7	9.6	9.8	14.5	5.4
8	23.0	23.4	7.4	12.6	16.0	4.8
9	17.3	2.0	6.9	15.5	10.8	6.2
10	10.2	2.4	13.2	12.1	31.0	7.0

In regard to the influence of advancing lactation on loss of fat in skim-milk, when the gravity method of creaming as described was used, we notice the following:

1. The *general* tendency exhibited is a greater loss of fat in skim-milk as lactation advances. This is especially noticeable in case of the Ayrshires and Devons, less so in case of the others. It should be stated that the results given for the Devons during the last two months of lactation were obtained by the centrifugal methods of creaming and should not be considered in this connection. In the case of the Jerseys and Holderness, we can not perceive that advancing lactation had any marked influence whatever upon loss of fat in creaming, while the increase of loss in the case of the Guernseys was slight. The milks richest in fat appear, on the whole, to be least influenced.

2. It, therefore, appears from the results in hand that it is not always true that advancing lactation diminishes the creaming efficiency of milk. The undoubted tendency in many or, perhaps, most cases is toward decreased creaming efficiency with advance of lactation, but breeds and individuals vary considerably in this respect as in others. In view of these results, any sweeping assertion to the effect that advancing lactation always and of necessity diminishes the creaming efficiency of milk-fat must be accepted with some allowances.

3. *Fat in cream.*

The tables below give, in another form, results which point in the same direction as those given above in regard to the influence of advancing lactation upon the creaming efficiency of milk.

TABLE SHOWING POUNDS OF FAT IN CREAM FROM 100 POUNDS OF MILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	3.18	3.34	5.98	4.41	......	5.66
2	3.19	3.35	4.95	3.19	3.01	4.87
3	2.98	3.43	4.37	2.99	3.08	4.93
4	3.02	3.73	4.42	3.02	3.07	5.50
5	2.98	3.66	4.80	2.90	2.60	5.27
6	2.74	4.23	4.56	2.97	3.40	5.21
7	2.70	3.72	4.37	3.02	3.02	5.41
8	2.70	3.40	4.49	3.05	3.13	5.51
9	3.01	5.46	4.58	3.03	3.49	5.37
10	3.01	4.55	4.45	3.03	2.73	5.40

TABLE SHOWING PER CENT. OF FAT IN MILK RECOVERED IN CREAM.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	90.9	94.3	97.3	87.8	......	92.7
2	92.1	90.0	96.5	88.2	83.8	92.4
3	87.9	86.6	94.7	88.5	79.9	95.1
4	88.7	86.7	95.9	87.2	84.4	95.8
5	88.1	82.3	96.1	88.7	71.0	92.9
6	82.7	82.6	92.6	88.9	86.7	91.2
7	78.0	75.3	90.4	90.2	85.5	94.6
8	77.0	76.6	92.6	87.4	84.0	95.2
9	82.7	98.0	93.1	84.5	89.2	93.8
10	89.8	97.6	86.8	87.9	69.0	93.0

4. *Fat in buttermilk.*

An examination of the tables below indicates that the loss of fat in buttermilk is variable and the variations, as a rule, appear to be independent of the influence of the period of lactation.

TABLE SHOWING POUNDS OF FAT IN BUTTERMILK FROM 100 POUNDS OF MILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1..........	0.05	0.01	0.17	0.12	......	0.15
2..........	0.07	0.02	0.05	0.05	0.40	0.08
3..........	0.11	0.02	0.03	0.07	0.17	0.06
4..........	0.10	0.01	0.02	0.04	0.21	0.04
5..........	0.09	0.03	0.02	0.02	0.11	0.04
6..........	0.06	0.03	0.02	0.05	0.07	0.11
7..........	0.12	0.04	0.04	0.04	0.03	0.04
8..........	0.12	0.02	0.03	0.02	0.03	0.04
9..........	0.06	0.09	0.05	0.03	0.01	0.02
10..........	0.13	0.04	0.10	0.08	0.05	0.03

TABLE SHOWING PER CENT. OF FAT IN MILK LOST IN BUTTERMILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness'.	Holsteins.	Jerseys.
1..........	1.8	0.4	1.3	2.2	......	2.5
2..........	1.9	0.5	0.8	1.3	11.2	1.8
3..........	3.2	0.5	0.6	2.2	3.2	1.5
4..........	2.7	0.3	0.5	1.0	7.0	0.7
5..........	2.3	0.7	0.4	0.7	3.1	0.7
6..........	1.8	0.5	0.4	1.5	1.9	1.9
7..........	3.2	0.8	0.3	1.1	0.8	0.5
8..........	3.2	0.5	0.6	0.4	0.9	0.6
9..........	1.7	1.6	1.2	0.8	0.3	0.3
10..........	1.4	0.9	2.0	2.3	3.0	0.5

5. *Fat in butter.*

Since the amount of fat lost in the buttermilk is comparatively slight, it is evident that what holds true in regard to the fat recovered in the cream is generally true regarding the fat recovered in the butter; and the data in the following tables follow those already made, viz., that advancing lactation tends, in some cases, to diminish the amount of fat recovered while, in other cases, the influence is slight or apparently nothing.

TABLE SHOWING POUNDS OF FAT IN BUTTER FROM 100 POUNDS OF MILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	3.07	3.32	5.75	4.15	......	5.23
2	3.06	3.28	4.76	2.97	2.33	4.56
3	2.76	3.32	4.24	2.77	2.77	4.56
4	2.80	3.60	4.37	2.94	2.43	5.11
5	2.79	3.30	4.66	2.82	2.43	5.13
6	2.65	3.92	4.42	2.90	3.27	4.90
7	2.49	3.25	4.23	2.98	2.91	5.19
8	2.46	3.38	4.43	2.94	3.07	5.39
9	2.77	4.88	4.52	2.97	3.35	5.17
10	2.80	4.46	4.35	2.64	2.60	5.31

TABLE SHOWING PER CENT. OF FAT IN MILK RECOVERED IN BUTTER.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	87.6	93.7	93.0	82.4	......	85.7
2	88.7	88.2	93.0	82.3	64.8	86.7
3	82.1	83.9	92.3	82.1	71.7	88.2
4	82.8	84.0	94.4	85.4	66.9	88.6
5	82.6	74.0	93.0	84.7	66.2	90.5
6	79.9	77.0	89.6	87.1	83.5	86.0
7	72.5	66.0	87.6	88.7	82.5	91.0
8	71.0	76.0	91.3	84.2	82.4	93.2
9	77.0	87.6	91.5	82.9	85.6	88.8
10	87.4	95.7	84.7	81.8	65.7	91.4

6. *Yield of butter.*

TABLE SHOWING POUNDS OF BUTTER (CONTAINING 85 PER CENT. BUTTER FAT) FROM 100 POUNDS OF MILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	3.60	3.91	6.76	4.88	......	6.15
2	3.60	3.86	5.59	3.51	2.74	5.36
3	3.25	3.91	5.04	3.26	3.26	5.36
4	3.29	4.24	5.14	3.45	2.86	6.01
5	3.28	3.88	5.48	3.31	2.86	6.03
6	3.12	4.61	5.20	3.42	3.85	5.77
7	2.96	3.83	4.98	3.49	3.42	6.11
8	2.90	3.98	5.20	3.45	3.62	6.35
9	3.29	5.74	5.32	3.50	3.94	6.08
10	3.31	5.25	5.12	3.10	3.06	6.24

7. *Butter-making efficiency of milk-fat.*

TABLE SHOWING POUNDS OF BUTTER MADE FROM ONE POUND OF MILK–FAT.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	1.00	1.10	1.05	0.96	......	1.00
2	1.01	1.03	1.09	0.95	0.76	1.00
3	0.93	0.99	1.09	0.96	0.84	1.03
4	0.95	0.97	1.11	1.00	0.77	1.03
5	0.95	0.88	1.10	0.99	0.74	1.06
6	0.93	0.87	1.05	1.02	0.97	1.00
7	0.82	0.78	1.02	1.04	0.96	1.06
8	0.79	0.90	1.07	0.99	0.97	1.09
9	0.86	1.03	1.06	0.97	1.00	1.05
10	0.91	1.17	1.00	0.88	0.77	1.07

6. *Yield of butter.*

Since the amount of standard butter that can be made from a pound of milk-fat depends upon the loss of fat in the process of making butter, the results must point in the same direction as those previously given. The amount of butter that can be made from a pound of milk-fat diminishes noticeably with advancing lactation in some cases, as with the Ayrshires and Devons, and, in a scarcely noticeable degree, with the Guernseys and Holderness. With the Jerseys and Holsteins there appeared to be an increase in the efficiency of the milk-fat for butter production.

INFLUENCE OF ADVANCING LACTATION UPON THE RELATIONS OF MILK TO CREAM AND BUTTER.

1. *Pounds of milk required to make one pound of butter.*

TABLE SHOWING POUNDS OF MILK REQUIRED TO MAKE ONE POUND OF BUTTER.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	27.8	25.6	15.0	20.5	......	16.3
2	27.8	25.8	17.9	28.5	36.5	18.7
3	30.8	25.6	19.8	30.7	30.7	18.7
4	30.4	23.6	19.5	29.0	35.0	16.6
5	30.5	25.8	18.3	30.2	35.0	16.6
6	32.1	21.7	19.2	29.2	26.0	17.3
7	33.8	26.1	20.0	28.7	29.2	16.4
8	34.5	25.1	19.2	29.0	27.6	15.8
9	30.4	17.4	18.8	28.6	25.4	16.4
10	30.2	19.1	19.5	32.8	32.7	16.0

2. *Pounds of milk required to make one pound of cream.*

TABLE SHOWING POUNDS OF MILK REQUIRED TO MAKE ONE POUND OF CREAM.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	5.64	5.23	3.64	5.29	......	4.19
2	6.30	5.54	3.66	6.49	7.36	4.17
3	6.52	5.66	3.76	6.35	6.47	4.22
4	6.56	4.85	3.34	5.38	6.49	3.93
5	6.85	5.48	3.88	5.26	7.87	3.94
6	5.92	4.82	4.13	4.63	5.21	3.59
7	6.54	4.48	3.91	5.07	6.41	3.63
8	6.84	5.13	3.63	6.06	6.21	3.77
9	6.08	4.23	3.54	5.84	5.85	3.93
10	5.43	4.72	3.66	4.75	7.00	3.51

3. *Pounds of cream required to make one pound of butter.*

TABLE SHOWING POUNDS OF CREAM REQUIRED TO MAKE ONE POUND OF BUTTER.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	5.00	4.92	4.24	3.90	......	3.89
2	4.51	4.70	4.93	4.48	4.97	4.53
3	4.87	4.54	5.29	4.86	4.76	4.44
4	4.73	4.94	5.87	5.44	5.51	4.31
5	4.56	4.71	4.70	5.76	4.50	4.21
6	5.63	4.70	4.67	6.36	5.00	4.87
7	5.36	5.83	5.17	5.66	4.56	4.53
8	5.28	4.90	5.30	4.78	4.45	4.19
9	5.28	4.12	5.39	4.91	4.37	4.20
10	5.30	4.04	5.35	6.89	4.69	4.60

4. *Per cent. of fat in cream.*

TABLE SHOWING PER CENT. OF FAT IN CREAM.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	18.00	17.42	21.42	23.22	......	24.17
2	20.55	18.56	18.14	20.79	22 14	20.06
3	19.20	19.40	16.61	18.99	20.02	21.20
4	19.68	17.90	14.85	16.29	19.99	21.52
5	20.14	19.92	18.72	15.21	20.40	20.84
6	16.12	19.70	18.74	13.79	17.74	18.50
7	16.95	16.68	17.03	15.30	19.48	19.70
8	17.31	17.44	16.18	18.52	19.49	20.83
9	18.19	23.14	16.16	17.65	20.47	21.04
10	17.88	19.53	16.10	14.58	19.13	18.78

No general statement regarding the influence of advancing lactation upon the amount of milk required to make a pound of butter can be made that will hold true of all the breeds. When the amount of fat in the milk increases, less milk is required to make a pound of butter, provided the increased amount of fat is not lost in the skim-milk and buttermilk. In the case of the Ayrshires, the amount of milk required to make a pound of butter gradually increases with advancing lactation; with the other breeds, the tendency appears to be a slight fluctuation about a certain point or else a tendency to a slightly diminished amount of milk for making butter.

In regard to the influence of advancing lactation upon the amount of milk required to make a pound of cream, the amount of cream required to make a pound of butter, and upon the per cent. of fat in the cream, it is impossible, from the data in hand to make any general statement. Such variations as there are appear more or less irregular and are not very marked.

THE INFLUENCE OF ADVANCING LACTATION UPON THE DAILY YIELD OF MILK AND BUTTER.

1. *Pounds of milk given per day.*

TABLE SHOWING POUNDS OF MILK GIVEN PER DAY.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	15.3	13.1	13.4	11 8	......	16.0
2	20.5	14.0	15.9	17.5	28.5	18.3
3	20.1	13.9	17.6	18.6	29.8	17.5
4	20.3	13.1	17.3	15.8	23.9	16.1
5	19.7	11.9	17.4	15.6	25.0	15.6
6	18.9	10.9	17.4	14.9	23.4	14.9
7	19.6	10.8	17.6	13.7	25.5	13.6
8	17.9	11.2	17.3	13.0	23.4	13.0
9	17.3	10.4	16.6	13.2	20.6	13.3
10	16.0	10.6	15.2	13.6	18.2	12.9

2. *Pounds of butter produced per day.*

TABLE SHOWING POUNDS OF BUTTER PER DAY.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	0.55	0.51	0.89	0.58	......	0.98
2	0.75	0.54	0.89	0.61	0.94	0.98
3	0.65	0 54	0.89	0.61	0.97	0.94
4	0.67	0.56	0.89	0.55	0.68	0.97
5	0.65	0.46	0.95	0.52	0.71	0.94
6	0.59	0.50	0.91	0.51	0.90	0.86
7	0.58	0.41	0.88	0.48	0.87	0.83
8	0.52	0.45	0.90	0.45	0.85	0.82
9	0.57	0.60	0.88	0.47	0.81	0.81
10	0.53	0.55	0.78	0.42	0.56	0.80

The general rule is an increased milk yield in the second month over the first month of lactation. In the case of the Ayrshires, Devons and Jerseys, the yield gradually, and with considerable regularity, decreased with each month of lactation. With the

Guernseys, Holderness and Holsteins, the highest yield of milk was in the third month of lactation, after which there was gradual diminution, except in the case of the Guernseys, and their average daily milk yield continued very nearly uniform through the first eight months of lactation before dropping noticeably.

In regard to daily yield of butter, it was highest in the second month of lactation with the Ayrshires, Holderness and Jerseys, after which there was a gradual diminution. The daily butter yield of the Devons increased during the first four months and then diminished. The butter yield of the Guernseys was uniformly the same during the first four months and reached its highest in the fifth month of lactation and then remained about the same as during the first four months up to the tenth month of lactation.

INFLUENCE OF ADVANCING LACTATION UPON THE MONTHLY YIELD OF DAIRY PRODUCTS.

1. *Monthly yield of milk.*

TABLE SHOWING POUNDS OF MILK GIVEN PER MONTH.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	260.2	205.9	250.4	150.8	......	341.1
2	636.3	418.3	491.7	541.2	884.0	527.3
3	596.4	428.4	520.0	558.0	895.0	487.8
4	642.7	398.8	509.3	489.2	780.6	452.5
5	611.2	362.8	529.6	483.9	780.5	484.3
6	619.1	335.2	530.0	416.6	725.1	443.6
7	609.2	323.5	537.0	425.0	790.1	408.7
8	545.7	346.0	527.0	390.7	655.8	395.7
9	539.5	311.9	512.2	407.8	638.1	407.9
10	512.4	328.6	463.7	407.6	544.7	395.7

2. *Monthly yield of skim-milk.*

TABLE SHOWING POUNDS OF SKIM-MILK PER MONTH.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	214.1	166.5	181.7	122.3	......	259.7
2	525.3	342.8	357.6	457.8	764.0	400.9
3	504.9	352.7	381.7	470.6	756.7	372.2
4	544.7	316.6	356.8	398.3	660.3	337.4
5	522.0	296.6	393.1	392.1	655.1	361.3
6	514.5	265.2	401.7	326.6	586.0	320.0
7	516.1	251.3	399.7	341.2	666.9	296.1
8	466.0	278.6	381.8	326.2	550.2	290.7
9	450.8	238.2	367.5	337.8	529.9	304.1
10	418.1	259.0	337.1	321.6	467.1	283.0

3. *Monthly yield of cream.*

TABLE SHOWING POUNDS OF CREAM PER MONTH.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	46.1	39.4	68.7	28.5	......	81.4
2	110.0	75.5	134.1	83.4	120.0	126.4
3	91.5	75.7	138.3	88.0	138.3	115.6
4	98.0	82.2	152.5	90.9	120.3	115.1
5	89.2	66.2	136.5	91.8	95.4	123.0
6	104.6	70.0	128.3	90.0	139.1	123.6
7	93.1	72.2	137.3	83.8	123.2	112.6
8	79.7	67.4	145.2	64.5	105.6	105.0
9	88.7	73.7	144.7	70.0	109.1	103.8
10	94.3	69.6	126.6	86.0	77.6	112.7

4. *Monthly yield of buttermilk.*

TABLE SHOWING POUNDS OF BUTTERMILK PER MONTH.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	36.9	31.4	52.5	21.2	......	60.5
2	87.7	59.5	106.7	64.8	95.8	98.5
3	72.7	59.0	112.1	69.9	109.3	89.6
4	77.3	65.6	126.4	74.1	98.5	88.4
5	69.7	52.1	107.5	75.8	74.2	93.8
6	86.0	55.2	100.5	75.8	111.5	98.2
7	75.7	59.8	110.8	69.0	96.2	87.8
8	64.3	53.7	117.8	51.0	81.9	80.0
9	71.6	55.8	117.9	55.8	84.1	79.1
10	76.4	52.4	102.9	73.6	61.0	91.9

5. *Monthly yield of milk-fat.*

TABLE SHOWING POUNDS OF FAT IN MILK PER MONTH.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	9.20	7.29	15.37	7.60	......	20.81
2	22.14	15.60	25.22	19.54	31.73	27.79
3	20.27	16.96	23.97	18.82	34.55	25.27
4	21.85	17.07	23.58	16.82	28.41	26.02
5	20.60	16.07	26.48	16.11	28.57	27.51
6	20.08	16.96	26.13	13.87	28.42	25.42
7	21.20	15.95	25.93	14.24	28.05	23.38
8	19.70	15.36	25.61	13.64	24.46	22.95
9	19.85	17.37	25.20	14.64	24.89	23.50
10	19.62	15.31	23.83	14.03	21.52	22.99

6. *Monthly yield of fat in butter.*

TABLE SHOWING POUNDS OF FAT IN BUTTER PER MONTH.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	7.8	6.8	13.8	6.2	......	17.8
2	19.0	13.6	23.3	15.8	20.6	23.7
3	16.0	14.2	22.3	15.4	24.7	22.1
4	17.6	14.1	22.2	14.3	18.5	22.7
5	16.6	12.0	24.7	13.6	18.0	24.8
6	15.8	12.6	23.4	12.1	23.5	21.6
7	14.8	10.5	22.5	12.6	23.0	21.1
8	13.1	11.7	23.3	11.5	20.1	21.2
9	14.5	15.2	22.8	12.1	21.2	21.0
10	15.2	14.6	20.1	10.5	14.1	20.8

7. *Monthly yield of butter.*

TABLE SHOWING POUNDS OF BUTTER PER MONTH.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	9.2	8.0	16.2	7.3	......	20.9
2	22.3	16.0	27.4	18.6	24.2	27.9
3	18.8	16.7	26.2	18.1	29.0	26.0
4	20.7	16.6	26.1	16.8	21.8	26.7
5	19.5	14.1	29.0	16.0	21.2	29.2
6	18.6	14.8	27.5	14.2	27.6	25.4
7	17.4	12.4	26.5	14.8	27.0	24.8
8	15.4	13.8	27.4	13.5	23.7	25.0
9	17.1	17.9	26.8	14.2	25.0	24.7
10	17.9	17.2	23.7	12.4	16.6	24.5

With most of the breeds, the largest milk yield was given in the second or third month, after which there was a gradual but not uniform diminution; with the Ayrshires, the highest yield was in the fourth month; with the Guernseys, in the seventh month.

In regard to yield of fat in milk, most of the breeds gave the largest yield in the second or third months, with a gradual but not uniform diminution afterwards, and the same was practically true in regard to the monthly yield of fat in butter and of butter.

Influence of advancing lactation upon temperature of churning.

TABLE SHOWING TEMPERATURE (IN DEGREES FAHRENHEIT) OF CHURNING.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	62	64	60	60	......	61
2	61	65	61	60	60	61
3	62	64	62	60	61	62
4	61	67	63	62	62	60
5	64	66	62	65	60	61
6	65	67	62	66	63	62
7	64	68	64	66	63	64
8	65	68	65	63	64	64
9	65	69	66	66	65	63
10	66	67	69	67	72	65

The general tendency is to an increase in temperature of churning as the period of lactation advances.

Influence of advancing lactation upon time of churning.

TABLE SHOWING LENGTH OF TIME (IN MINUTES) OF CHURNING.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	28	35	17	66	......	33
2	30	31	19	53	40	46
3	34	36	32	49	67	38
4	35	70	36	76	91	53
5	35	39	34	85	75	63
6	41	68	44	86	137	71
7	60	53	32	102	100	92
8	41	91	42	72	87	57
9	62	55	26	56	134	55
10	60	35	28	83	......	53

The general tendency is to an increase in the length of time required for churning as the period of lactation advances.

Influence of advancing lactation upon fat globules of milk.

TABLE SHOWING RELATIVE NUMBER OF FAT GLOBULES.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	62	68	61	......	......	49
2	66	68	46	67	53	53
3	70	99	52	68	67	45
4	85	77	76	87	132	86
5	93	152	64	79	95	56
6	94	144	70	104	66	76
7	117	186	103	111	94	62
8	140	241	89	94	123	80
9	168	225	120	116	132	83
10	162	211	104	106	168	103

TABLE SHOWING RELATIVE SIZE OF FAT GLOBULES.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	687	546	928	......	......	1104
2	580	585	1063	661	640	1098
3	624	450	954	607	576	1228
4	426	547	659	501	256	1097
5	384	319	837	397	396	1149
6	399	355	737	324	595	846
7	322	270	584	329	340	1017
8	298	200	568	379	310	733
9	241	250	408	315	384	715
10	248	228	426	336	248	571

From the foregoing data, it appears that advancing lactation is generally accompanied by an increase in the relative number and a diminution in the relative size of the fat globules.

XVII. THE INFLUENCE OF ADVANCING LACTATION UPON THE PRODUCTION OF CHEESE.

CASEIN AND ALBUMEN IN MILK.

An examination of the table below indicates a general increase of casein and albumen in the milk after the first month, as the period of lactation advances.

TABLE SHOWING POUNDS OF CASEIN AND ALBUMEN IN 100 POUNDS OF MILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	3.37	4.00	4.00	3.40	......	3.51
2	2.98	3.27	2.88	2.88	2.88	3.46
3	2.99	3.65	3.02	3.20	2.83	3.72
4	3.35	3.63	3.56	2.97	3.05	3.65
5	3.44	3.70	3.51	2.70	3.17	3.72
6	3.42	4.29	3.56	3.13	3.58	3.72
7	3.19	3.91	3.68	3.38	2.94	4.03
8	3.30	3.90	3.75	3.27	2.93	3.96
9	3.62	4.04	3.83	3.61	3.67	4.06
10	3.70	3.73	4.24	3.37	4.01	3.92

Ratio of fat to casein and albumen in milk.

TABLE SHOWING NUMBER OF POUNDS OF FAT FOR ONE POUND OF CASEIN AND ALBUMEN IN MILK.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	1.05	0.89	1.53	1.48	......	1.74
2	1.17	1.14	1.78	1.25	1.25	1.52
3	1.13	1.09	1.53	1.05	1.36	1.40
4	1.01	1.18	1.30	1.16	1.19	1.57
5	0.98	1.20	1.42	1.23	1.15	1.52
6	0.95	1.18	1.88	1.06	1.09	1.54
7	1.09	1.26	1.31	1.00	1.21	1.42
8	1.09	1.14	1.30	1.07	1.27	1.46
9	1.02	1.37	1.28	1.00	1.07	1.42
10	1.04	1.25	1.21	1.02	0.99	1.48

In the table above we show the number of pounds of fat for one pound of casein and albumen in milk during the period of lactation. In the case of the Ayrshires, the ratio increases and decreases without any marked uniformity during the period of lactation. With the Devons, the ratio increases as lactation advances, while in the other breeds the ratio decreases as lactation advances. The loss of fat in the process of manufacture should be less in the latter case.

Pounds of cheese made from milk.

TABLE SHOWING POUNDS OF CHEESE MADE FROM 100 POUNDS OF MILK.

MONTH OF LACTATION.	Ayrshires	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	10.38	10.87	13.23	11.81	......	12.69
2	10.03	10.49	11.44	10.07	10.06	11.91
3	9.96	10.99	11.07	10.09	10.27	12.03
4	10.24	11.28	11.50	9.99	10.23	12.49
5	10.28	11.47	11.80	9.68	10.34	12.47
6	10.18	12.51	11.78	10.00	11.48	12.52
7	10.19	12.10	11.78	10.22	10.07	12.75
8	10.40	11.63	11.86	10.26	10.23	12.77
9	10.71	12.79	12.09	10.62	11.02	12.81
10	10.91	11.70	12.49	10 29	11.26	12.75

TABLE SHOWING POUNDS OF MILK REQUIRED TO MAKE ONE POUND OF CHEESE.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	9.63	9.20	7.56	8.46	.....	7.90
2	9.97	9.53	8.74	9.93	9.94	8.40
3	10.04	9.01	9.03	9.91	9.73	8.31
4	9.77	8.86	8.70	10.01	9.77	8.00
5	9.73	8.72	8.47	10.33	9.67	8.02
6	9.82	8.00	8.49	10.00	8.71	8.00
7	9.81	8.26	8.48	9.78	9.93	7.84
8	9.61	8.60	8.43	9.74	9.77	7.82
9	9.34	7.81	8.27	9.41	9.07	7.80
10	9.14	8.55	8.00	9.71	8.88	7.84

It appears from the above data that less milk is required to make cheese as the lactation period advances. This would naturally follow from the fact that the fat and casein increase as lactation advances, and, moreover, in most cases, there should be less loss of fat as lactation advances, since, in general, there is more casein in proportion to fat as lactation advances.

MONTHLY YIELD OF CHEESE.

TABLE SHOWING AVERAGE MONTHLY YIELD OF POUNDS OF CHEESE.

MONTH OF LACTATION.	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
1	49.13	34.44	50.95	44.56	......	61.68
2	63.82	43.90	56.26	54.50	88.93	62.77
3	59.40	47.55	57.59	56.37	92.00	58.70
4	65.78	45.01	58.54	48.87	79.84	56.56
5	62.82	41.61	62.53	46.84	80.71	60.39
6	63.04	41.90	62.42	41.66	83.25	55.45
7	62.10	39.17	63.32	43.50	79.57	52.13
8	56.78	40.23	62.52	40.11	67.12	50.60
9	57.76	40.00	61.93	43.34	70.35	52.30
10	56.06	38.43	57.96	42.00	61.34	50.47

The monthly yield of cheese increased, in most cases, during the first two or three months of lactation and then gradually diminished. In the case of the Guernseys, the yield increased during the first seven months and then slowly diminished.

XVIII. HOW TO ASCERTAIN THE BUTTER-MAKING EFFICIENCY OF MILK-FAT.

The recent practical methods devised for the purpose of finding out how much fat milk contains, have made it easily possible for any farmer to ascertain the amount of fat in the milk of each of his cows. The question is at present being often asked: "*Does the amount of fat indicate how much butter one can make from the milk?*" The question can be answered by both "Yes" and "No." If one knows only the amount of fat in the milk, and nothing more, it simply indicates how much butter might be made, if no fat were lost in the creaming and churning, and that no more than this amount could be made. Even in this case, to calculate the theoretical amount of butter that could be made, one should know how much fat the butter is to contain, whether eighty or eighty-five per cent. In our work, we have adopted as our standard, butter containing eighty-five per cent. of fat. Hence, to calculate from the amount of fat in milk the greatest theoretical amount of butter that could be made from such milk, we divide the per cent. of fat in the butter by 0.85, or multiply by 1.175, and the result will be the amount of butter that could be made from 100 pounds of milk, provided no fat were lost in the process of making. For example, if a sample of milk is found to contain 3.85 per cent. of fat, 3.85 divided by 0.85, or multiplied by 1.175, will give 4.53 pounds of butter for 100 pounds of milk. But we know that, in actual experience, no such amount can be fully realized. Then, under what conditions, is the amount of fat in the milk an accurate indication of the amount of butter that can be made from the milk? We may mention three principal conditions :

1. If a process of creaming is employed which removes a uniform amount of fat from the milk, regardless of special conditions, such as time of lactation, size of fat globules, etc. For example, good centrifugal machines, properly managed, will very uniformly separate the fat from the milk, leaving, as a rule, less than one-tenth of one per cent. of fat in the skim-milk.

2. If the cream is properly handled in the process of churning, so as to reduce the loss of fat to a uniform minimum.

3. If the butter is salted and worked so as to make a uniform product, containing a certain proportion of fat.

In order that we may know closely how much butter milk-fat will make, we must, then, know (a) the amount of fat in the milk, (b) the amount of fat that must, of necessity, be lost in the process of manufacture, and (c) the kind or quality of butter made. To illustrate, suppose a milk contains five per cent. of fat. In the creaming process, we lose about 0.1 per cent. and in churning about 0.02 per cent. That would leave for making butter 4.9 pounds of fat for each hundred pounds of milk. This amount of of fat divided by 0.85 or multiplied by 1.175 would give 5.76 pounds of butter. Then dividing 5.76, the amount of butter made, by 5, the amount of fat in the butter, we get 1.15, the amount of butter that is made for each pound of milk-fat. Then, in such a case, where the loss of fat is no greater, we can find out the amount of standard butter that we shall make from 100 pounds of milk by multiplying the per cent. of fat in the milk by 1.15.

From the preceding discussion, it becomes evident that, under the following conditions, the amount of fat in the milk is no accurate guide as to the amount of butter that will be made from the milk:

1. If a method of creaming, as any ordinary gravity method of setting, is employed, which can not be relied upon to give uniform results for the same milk from day to day and for milk from different individuals.
2. If methods are employed in the process of churning, which do not give uniform results in the loss of fat.
3. If the butter is salted and worked without producing a fairly uniform product, making, one day, a product containing seventy-five per cent. of fat and, another day, a product containing eighty or eighty-five per cent. of fat.

No gravity process of creaming is yet known that can be relied upon to cream all kinds of milk, even under the same conditions, with anything like equal or uniform efficiency. A study of the results presented in connection with the comparison of breeds of dairy cattle in regard to butter production shows this truth very strikingly. This can well be shown by presenting simply the figures that show how much butter was made from a pound of fat in the milk of the different breeds: 1.07, 1.04, 0.98, 0.97, 0.93, 0.88. These numbers are not uniform and a study of individuals reveals much greater differences.

XIX. COMPARISON OF METHODS OF CREAMING MILK BY SETTING AND BY CENTRIFUGAL MACHINE.

In carrying on the investigation of dairy breeds of cattle, it was proposed to use for creaming the milk during the second period of lactation the De Laval "Baby Separator No. 2." As a preliminary to carrying out this plan, the separator was used with all the cows, whether in first or second period of lactation, the results being compared with those obtained in the month previous by the deep-setting process in Cooley cans and vat, in water at a temperature of about 40° F. The "Baby" separator was run at a speed of 6,200 revolutions per minute and the temperature of the milk was from 85° to 90° F.

The following averages from ten cows indicate the difference in the results obtained by the two methods :

	Gravity method.	"Baby" Separator.
Pounds of milk required to make one pound of butter,	32.04	23.17
Per cent. of milk-fat recovered in cream..........	78.5	97.9
Per cent. of milk-fat recovered in butter	70.2	93.0
Pounds of butter per month	15.9	20.7

In the case of one animal, whose milk at all times has refused to cream by any gravity process employed, the yield of butter was increased from 13.9 pounds to 24.1 pounds by using the separator. The average gain was a little less than five pounds.

XX. ANALYSES OF MATERIALS USED IN SPRAYING PLANTS.

Most of the substances commonly used at present in spraying plants contain some compound of copper ; in some instances the copper compounds and other necessary materials are purchased separately, and the mixing is done at home, while, in other cases, special preparations, containing copper compounds and other essential ingredients, mixed ready for application, which are found in the market, are used. The sale of copper compounds in the form of crude materials and of special preparations has increased enormously in the past year or two and, therefore, offers an inviting field for adulteration and imposition.

During the past year, the chemist has examined several copper compounds separately and also some of the special preparations that are being put upon the market. The investigation was undertaken with a view to finding out something in regard to the following points :

1. Whether copper compounds are adulterated.
2. To what extent they are adulterated, if at all.
3. Whether the special preparations put on the market are pure ; whether they are mixed in proper proportions, and whether they are offered for sale at reasonable prices.

Samples of four different kinds of materials have been examined, as follows:

1. Copper sulphate in three different forms.
   - (*a*) Crystals of copper sulphate.
   - (*b*) Crystals of copper sulphate, powdered.
   - (*c*) Dried or anhydrous copper sulphate.
2. Copper carbonate in two forms.
   - (*a*) Precipitated copper carbonate.
   - (*b*) "Hydrated" copper carbonate.
3. A prepared mixture called "Copperdine," as put up for 1891 and for 1892.
   - (*a*) Copperdine in dry form.
   - (*b*) Copperdine in solution.
4. A sample of prepared Bordeaux mixture.

PROPERTIES OF COPPER SULPHATE.

In order that some of the points connected with the analysis of the various samples of copper sulphate may be more clearly understood, a few statements are made regarding some of the properties of copper sulphate before presenting the results of analysis.

Copper sulphate, commonly called blue vitriol, blue stone or copper vitriol, may occur in three forms or conditions. In the form with which we are most familiar, it appears in crystals, varying in size, of a beautiful blue color. One hundred pounds of it contain the following amounts of different elements:

	Pounds.
Copper	25.4
Sulphur	12.8
Oxygen	57.8
Hydrogen	4.0

The four pounds of hydrogen are combined with thirty-two pounds of the oxygen, forming thirty-six pounds of water, which is known commonly as water of crystallization. The remaining 25.8 pounds of oxygen are combined with the sulphur in the same manner as in sulphuric acid, and the oxygen and sulphur, combined with the copper in the proportions above given, together with the water, form crystallized copper sulphate. Stating its composition in a somewhat different form, we can say that crystallized copper sulphate contains in 100 pounds:

	Pounds.
Copper	25.4
Sulphuric acid (combined)	38.6
Water	36.0

Now, if we heat 100 pounds of copper sulphate in an oven to the temperature of boiling water, the crystals will gradually lose their color and crumble to pieces, leaving a bluish-white powder. At this temperature, twenty-nine of the thirty-six pounds of water are driven off. If this powder is heated to 400° F, the remaining seven pounds of water will be driven off and we shall obtain a white powder, which is called *anhydrous* or *dehydrated copper sulphate;* that is, copper sulphate free from water. This form of copper sulphate is being put upon the market for spraying mixtures. It has the advantage of being in a finely powdered condition and in a more concentrated form, containing, as it does, if pure, forty pounds of copper per hundred. It possesses the disadvantage of absorbing moisture from the air rapidly, which renders the composition uncertain.

ANALYSES OF COPPER SULPHATE.

1. The first sample of copper sulphate examined was obtained by Mr. D. G. Fairchild from the Nichols Chemical Company (Laurel Hill Chemical Works), 45–49 Cedar street, New York city. This sample contained 99.6 per cent. of copper sulphate This was practically pure. In order to make sure that this sample was not misleading, another sample was obtained from the company through Mr. Morton Minot of Brockport, and thus gave the same results, on analysis, as the first sample.

2. The next sample of copper sulphate was obtained from one of the drug stores in Geneva. It contained 98.1 per cent. of copper sulphate.

3. The third sample of copper sulphate was sent to the Station for analysis by Mr. J. Burroughs, West Park, N. Y. It contained 98.6 per cent. of copper sulphate. This sample contained a considerable amount of free or uncombined sulphuric acid, which had partially destroyed or eaten the paper wrapped around it.

The presence of the free sulphuric acid would not render the copper sulphate injurious, if it were intended for use in the Bordeaux mixture or for the preparation of copper carbonate, since, in either case, the free acid would be completely removed or neutralized in such a way as to form a harmless compound.

4. The fourth sample of copper sulphate examined was in powdered form; that is, the ordinary crystallized copper sulphate reduced to a fine powder by grinding. This was obtained from W. S. Powell & Co., Baltimore, Md., and contained 98.1 per cent. of copper sulphate. This sample contained noticeable quantities of dirt, which was present probably by accident rather than by design. It is readily seen that powdered copper sulphate offers a better opportunity for adulteration than do the large crystals.

5. The next sample was crystallized copper sulphate, sent out by W. S. Powell & Co. for the season of 1892. It contained 99.6 per cent. of copper sulphate.

6. The sixth sample was powdered crystallized copper sulphate, from W. S. Powell, for the season of 1892. It had evidently lost some of its water of crystallization and was, therefore, found to contain about one per cent. more of copper than ordinary crystallized copper sulphate. The sample contained a small amount of insoluble dirt.

7. The seventh and last sample of copper sulphate was called "dried copper sulphate," and was sent out by W. S. Powell & Co. for the season of 1892. This sample was found to contain 90.8 per cent. as much copper sulphate as copper sulphate which has been thoroughly dried at 212° F. should contain, or 81.8 per cent. as much as should be contained in copper sulphate which has been dried completely at 400° F. Copper sulphate in this form very readily absorbs moisture, and the diminished per cent. was doubtless due to the fact that after it was dried it absorbed some moisture. The sample contained some dirt. The main objection to be urged against buying copper sulphate in this dried form is that the composition is very apt to be uncertain, owing to its tendency to absorb moisture when it is exposed to the air.

PROPERTIES OF COPPER CARBONATE.

Copper carbonate is a somewhat complex chemical compound, and it would take us too far into chemistry to attempt to explain its composition in detail. Suffice it to say that most of the copper carbonate we have to deal with contains, if pure, in 100 pounds:

	Pounds
Copper	57.4
Carbon	5.4
Oxygen	36.3
Hydrogen	0.9

It is known in nature in crystalline form under the name of malachite. Copper carbonate, when made by precipitation, as is the case in the common methods of artificial preparation, is a greenish powder. Unless thoroughly washed, it will contain some sulphate, when made in the ordinary way. The sulphate probably does no harm in spraying mixtures when the quantity is small.

ANALYSES OF COPPER CARBONATE.

1. The first sample of copper carbonate examined was obtained at one of the Geneva drug-stores. It contained 88.1 per cent. of copper carbonate. The sample dissolved to a clear solution in acids, except a small amount of dirt which remained in suspension. The diminished per cent. of copper carbonate was probably due to the presence of some moisture, though this was not determined.

2. The second sample was obtained from another drug-store in Geneva. It contained 62.8 per cent. of copper carbonate. This sample contained a considerable quantity of some kind of white powder, which failed to dissolve in nitric acid. The presence of this insoluble matter, coupled with the low per cent. of copper carbonate, gave evidence of serious adulteration. With pure copper carbonate at forty cents a pound, this sample was worth not over twenty-five cents a pound.

3. The third sample of copper carbonate came from W. S. Powell & Co., Baltimore, Md., and was put up for the season of 1892. It contained 89.4 per cent. of copper carbonate. It was found to be not entirely free from sulphate. It did not make a perfectly clear solution in acids.

4. The fourth sample was called "hydrated copper carbonate. So far as could be ascertained, this "hydrated" compound is nothing more than the ordinary copper carbonate saturated with water. Taking the mixture as it was, it contained 59.4 per cent.

of copper carbonate. It was not entirely free from dirt and contained a considerable amount of sulphate. There is one advantage in having the copper carbonate saturated with water, it dissolves more readily in ammonia. This, however, is an operation that is not beyond the ability of the average fruit-grower, who could himself well moisten the carbonate with water before treating with ammonia. The objections to putting such a form on the market are (1), that it is not needed, since any one can "hydrate" his copper carbonate by mixing it with water; (2) the manufacturer places no guarantee upon it, and it contains less than sixty per cent. as much copper carbonate as the simple dry copper carbonate. It would be possible to overcome this latter objection.

ANALYSES OF "COPPERDINE."

1. The first sample of copperdine analyzed was in dry form, prepared for the season of 1891. It was put up in a two-pound can and claimed to be a mixture of copper carbonate and ammonium carbonate, in the proportions recommended by the United States Department of Agriculture. The price of the two-pound can was seventy-five cents. The materials were not very well mixed, so, in order to obtain a fair sample for analysis, over half of the contents of the can was removed and mixed thoroughly; from this a sample was taken for analysis. The mixture, on analysis, was found to contain nearly seven per cent. of copper, which would be equivalent to about two and one-quarter ounces of copper in the whole two-pound can. This amount of copper is equivalent to about eight and three-quarters ounces of copper sulphate, or to about four ounces of copper carbonate. The two pounds of dry copperdine, therefore, contained about four ounces of copper carbonate and twenty-eight ounces of ammonium carbonate. If these materials were purchased at retail at a drugstore in Geneva, they would cost as follows:

	Cents.
Four ounces of copper carbonate, at forty cents per pound......	10
Twenty-eight ounces ammonium carbonate, at eleven cents per pound..	19
Total cost of materials in two pounds of dry copperdine....	29

If the copper carbonate were made from copper sulphate and sal soda, the cost of four ounces would be about four cents, instead of ten cents, and this would reduce the cost of two pounds of copperdine to twenty-three cents. Allowing for the cost of mixing, which is very slight, and of the tin can, in which the material is put up, two pounds of copperdine can hardly cost the manufacturer more than thirty or thirty-five cents. As each two-pound can sells for seventy-five cents, the margin of profit is not difficult to calculate.

Another question arises in connection with the use of this mixture, and that is this, "Is it properly prepared so that when used in accordance with the directions given, it will not be too weak or too strong? The directions on the can indicate that the two pounds of material are to be dissolved in forty gallons of water, making an equivalent of about one ounce of copper carbonate to ten gallons of water, which is the exact strength recommended by the United States Department of Agriculture.

The mixture easily dissolved in water, forming a clear solution. While this preparation is properly made, so far as regards strength, the fruit-growers can decide whether it is the most economical form to purchase for use.

2. Another sample of dry copperdine, as prepared for the season of 1892, was examined. Its general characteristics were like those of the first sample. It was found to contain 7.35 per cent. of copper, equivalent to about one-tenth of an ounce more of copper than the first sample. It was found to contain some sulphate. When dissolved in water, the solution was turbid and dirty. This sample was sent out under the name of "ammoniated carbonate of copper."

3. The "liquid copperdine," as put up for 1891, was found to contain two per cent. of copper, equivalent to about one and one-eighth ounces of copper carbonate. The liquid form, therefore, contained a little more than one-fourth the copper carbonate contained in the dry form. The cost of its materials, reckoned on the same basis, would be eight and one-half cents. Allowing for cost of mixing and of can, the total cost of two pounds of "liquid copperdine" might, perhaps, approximate as high as twelve or fifteen cents. Each two-pound can sold for fifty cents, giving a considerably increased rate of profit, even over the dry form.

As regards its strength, when used according to directions, the liquid form as put up for 1891 was found too dilute. The directions for using are to dilute the contents of one two-pound can in seven bucketfuls of water, which may mean anywhere from twenty to thirty gallons. Taking the lower number, we should then have an equivalent of one and one-eighth ounces of copper carbonate to twenty gallons of water, while the official proportions are an equivalent of one ounce of copper carbonate in ten gallons of water. The solution made from this "liquid copperdine" for 1891 was, therefore, only about half as strong as the official solution; and, if one used thirty gallons of water for dilution, then the solution would be only one-third as strong as it should.

4. A sample of "liquid copperdine," as prepared for the season of 1892, was also examined. It was found to contain 4.73 per cent. of copper, or nearly two and one-half times as much copper as the sample prepared for 1891. This mixture is, therefore, of proper concentration. It is a solution of copper carbonate in ammonia. It contained some sulphate.

ANALYSIS OF "PREPARED BORDEAUX MIXTURE."

This sample was from a lot prepared for the season of 1892. It is put up in dry form. It was found to contain 11.62 per cent. of copper. The official mixture contains 15.24 per cent. of copper. Hence this "prepared" Bordeaux mixture contains only 76.2 per cent. as much copper as it should contain. This may be due to incomplete mixing of materials.

SUMMARY OF RESULTS.

1. *Copper sulphate*, in the form of large crystals, may be relied upon as being fairly pure; but, when it is in the form of powder, it is always safe to test its purity. The dried form of copper sulphate is objectionable on account of the uncertainty of its composition, which changes on exposure to air, and, being in powdered form, it can readily be adulterated. The comparatively low price of copper sulphate does not offer the temptation for adulteration that the more expensive form of carbonate does.

2. *Copper carbonate*, on account of its relatively high price, and also on account of its finely divided condition is, probably, quite liable to adulteration, and should always be tested. All the

samples that were tested for sulphate showed its presence, but probably not to an injurious extent.

3. "*Copperdine*," in dry form, costs the fruit-grower twice as much as he himself could prepare it for, but contains the proper amount of copper.

"Copperdine" in liquid form, as put up in 1891, cost three or four times as much as it could be prepared for, and contained only one-half or one-third as much copper as it should. It was, therefore, worse than worthless, since its use would mislead fruit-growers. However, the sample for 1892 proved to be up to official strength. The samples of copperdine for 1892 showed the presence of sulphates.

4. The "prepared" Bordeaux mixture for 1892 does not appear to be up to the required official strength.

HOW TO DETECT IMPURITIES IN COPPER COMPOUNDS.

While the help of a chemist is needed to tell how much copper a substance contains, a few suggestions may be given which will enable anyone to test roughly samples of copper sulphate and copper carbonate, as well as Paris green, in regard to their purity.

1. *Copper sulphate*, if pure, should dissolve completely in warm water, making a clear solution, free from sediment or suspended matter.

2. *Copper carbonate* should dissolve completely in nitric acid, commonly called aqua fortis. If it does not dissolve completely, it is impure and probably adulterated. Copper carbonate, if pure, should also dissolve completely, or nearly so, in strong ammonia water, used in considerable quantity. Both the foregoing tests should be applied. Of course, copper carbonate could be adulterated by using finely powdered or dried copper sulphate, but this could easily be detected by treating with water, since copper sulphate easily dissolves in water, while copper carbonate does not.

3. *Paris green* should, if pure, dissolve completely in strong ammonia water, used in liberal quantity.

Such simple tests as the foregoing may be applied by anyone, and while they will not prove an infallible guide, they will serve as a fairly reliable indication regarding the purity of the compounds mentioned. When adulterants are added, they have generally been found to exist in the form of some finely powdered white substances, such as barium sulphate, gypsum, etc., which are insoluble in water, acids or alkalies.

IMPORTANCE OF USING PURE CHEMICALS AND MIXTURES.

Contradictory results have been obtained in using copper compounds and prepared mixtures for spraying fruit trees, grape vines, etc. It is suggested that, in many cases, the widely varying results may have been due to the use of impure copper compounds, which failed to make spraying mixtures of the required degree of strength. The use of commercially prepared mixtures of inferior strength may also account for some failures. It can readily be seen that purity and strength of chemical preparations are absolutely necessary, if trustworthy results are to be expected.

CONCLUSION.

Fruit-growers who have to use large quantities of copper compounds should, for the sake of economy, buy the separate ingredients of some reliable house, that can guarantee purity. They should test their compounds, to make doubly sure, and should do their own mixing. Persons who have occasion to use only small amounts of spraying mixtures may find it advantageous and economical of time to purchase prepared mixtures ready for use, provided they can be sure that the preparation is reliable in strength, and not extravagantly high in price.

XXI. ANALYSES OF SPRAYED GRAPES.

In September, 1891, the New York city board of health seized and destroyed large quantities of grapes, on the ground that they had been sprayed with copper compounds and were poisonous. This action caused a serious loss to many grape-growers. Mr. D. G. Fairchild, representing the United States Department of Agriculture, visited the Hudson river region, where the grapes were grown which had been seized. He took pains to secure the worst sprayed branches of grapes obtainable from those vineyards from which the condemned grapes came. These samples were given to the chemist of this station for analysis.

In some instances, the copper compounds could be seen upon the berries, but it could be seen to be more plentiful upon the stems. In three samples, the berries were separated from the stems and the amount of copper determined upon each. In one instance, the berries and stems were not separated. Mr. Jenter assisted in making the determinations.

The samples from Marlborough were taken from two different vineyards. The samples 3 and 3a were from the same vineyard; in sample 3a, the copper was estimated upon the berries and stems together and not separately. In the table below, the copper is given as metallic copper, the number of grains found for one pound of berries and stems.

LOCALITIES WHERE SAMPLES OF GRAPES WERE OBTAINED.	From One Pound of Berries and Stems.		
	Grains, estimated as metallic copper, on berries.	Grains, estimated as metallic copper, on stems.	Grains, estimated as metallic copper, on berries and stems.
(1.) Milton, N. Y	$\frac{1}{120}$	....	$\frac{1}{50}$
(1.) Milton, N. Y	....	$\frac{1}{90}$	
(2.) Marlborough, N. Y.....	$\frac{1}{120}$	....	$\frac{1}{40}$
(2.) Marlborough, N. Y.....	....	$\frac{1}{60}$	
(3.) Marlborough, N. Y.....	$\frac{1}{120}$	....	$\frac{1}{12}$
(3.) Marlborough, N. Y.....	....	$\frac{1}{14}$	
(3a.) Marlborough, N. Y....	....	....	$\frac{1}{16}$
Average for all samples.	$\frac{1}{120}$	$\frac{1}{30}$	$\frac{1}{20}$

The results embodied in the table above, we may summarize as follows:

1. The amount of copper, estimated as metallic copper, found on the *berries*, was very constant in the different samples, averaging one one-hundred-and-twentieth of a grain for each pound of fruit (berries and stems).

2. The amount of copper, estimated as metallic copper, found on the *stems*, varied from one-ninetieth to one-fourteenth of a grain for each pound of fruit (berries and stems), and averaged one-thirtieth of a grain.

3. If the copper were on the berries in the form of sulphate of copper, each pound of berries would contain about one-thirtieth of a grain of copper sulphate. When copper sulphate is prescribed by physicians as a tonic or astringent, the dose is from one-fourth to two-grains. Hence, if a person were to eat and swallow the grapeskins as well as the pulp of the berry, it would be necessary to eat from seven and one-half to sixty pounds of grapes, in order to get a tonic dose of copper sulphate. Or, if one were to eat berries and stems, it would be necessary to eat from one and one-quarter to ten pounds, to get a tonic dose of copper sulphate.

To get an amount of copper that would be regarded as serious, if taken at one dose, one would need to eat not less than 3,000 pounds of grapes, skins included, or not less than 500 pounds, including berries and stems; and it is safe to say, that if an attempt were made to get a dangerous dose of copper into the body in this way in a short time, a person would be in a dangerous condition, many times, from the grapes alone, before running any risk from the copper. To state the matter in another way, if one were to eat, each day, one pound of these worst sprayed grapes, including the skins, and if all the copper taken in this way were to accumulate in the body, it would require over eight years to accumulate an amount of copper that would, if taken at one dose, be considered dangerous, not necessarily fatal.

4. As a matter of fact, copper, when found upon sprayed grapes in New York State, exists, not in the form of a sulphate, but in the form of a carbonate or hydroxide, both of which forms are not readily soluble and which would, therefore, be even less dangerous than if present in the form of sulphate of copper. Most of the copper found was on the stems, which people do not eat; and the rest of the copper was on the outside of the skin of the berries, which most people do not eat.

5. The results obtained from estimating by chemical analysis the amount of copper on grapes, which were selected as being the worst sprayed that could be found, therefore, seem to justify the assertion that it is simply an absolute impossibility for a person to get enough copper from eating grapes to exercise upon the health any injurious effect whatever.

XXII. EXPLANATION OF TERMS OF CHEMICAL ANALYSIS IN RELATION TO FERTILIZERS.

By turning to the tables containing the analyses of fertilizers at the end of this report, it will be noticed that the following terms are used to express the results of the analysis of fertilizers :

Nitrogen.— Determined as nitrogen ; equivalent to ammonia.

Phosphoric Acid.— Available ; insoluble ; total.

Potash soluble in water.— Determined as potash.

The figures that are used to express the results of chemical analysis indicate *parts per hundred*, or, in other words, *how many pounds there are of each constituent in* 100 *pounds of fertilizer.* For example, take No. 119 ; under "Determined as nitrogen," we find the number, 3.49, which means that in 100 pounds of fertilizer there are 3.49 pounds of nitrogen. This amount of nitrogen is equivalent to 4.24 pounds of ammonia. Likewise, 100 pounds of the same fertilizer contain 13.21 pounds of available phosphoric acid, 0.43 pound of insoluble phosphoric acid, 13.64 pounds of total phosphoric acid, and 2.92 pounds of potash soluble in water.

NITROGEN.

1. *Determined as nitrogen.*

Nitrogen is a gas and, in this form, can not be used in fertilizers. Therefore, whenever we speak of nitrogen in fertilizers, we do not mean that nitrogen exists in them as simple nitrogen. The nitrogen in fertilizers is always combined with other elements and may be present in one or more different forms —(1st) in the form of nitrates, as nitrate of soda ; (2d) in the form of ammonia compounds, as sulphate of ammonia ; and (3d) in the form of organic matter, animal or vegetable, as dried blood, meat, tobacco stems, etc. Chemical analysis according to official methods does not attempt to ascertain and state in which form or forms the nitrogen is present in a fertilizer. Therefore, *the numbers in the column under* "DETERMINED AS NITROGEN" *are intended to state simply the amount of nitrogen present without regard to the form in which it is present*, or, expressed in another way, how much nitrogen there would be, if it were present in the form of pure nitrogen or nitrogen gas.

2. *Nitrogen equivalent to ammonia.*

Ammonia consists of *nitrogen combined with hydrogen.* A pound of nitrogen will form more that a pound of ammonia, because the ammonia formed from a pound of nitrogen will contain that pound of nitrogen plus the necessary amount of hydrogen added to form ammonia. The chemical relations of nitrogen and ammonia are such that fourteen pounds of nitrogen will unite with exactly three pounds of hydrogen, and will, therefore, produce just seventeen pounds of ammonia; or one pound of nitrogen will make 1.214 pounds of ammonia. The figures contained in the column under "Equivalent to ammonia" are, therefore, obtained by multiplying the figures in the column under "Determined as nitrogen" by 1.214. The figures in the "Equivalent to ammonia" column do not indicate that the fertilizers actually contain those amounts of ammonia, for they may contain no ammonia compounds at all, but it is intended to state under "EQUIVALENT TO AMMONIA" *simply how much ammonia there would be, if the nitrogen were all in the form of Ammonia.*

If, as is the usual practice, the manufacturer's guarantee analysis states the amount of nitrogen only in the form of ammonia, and if it is desired to know how much nitrogen the ammonia contains, simply multiply the number representing the amount of ammonia by .8235, since one pound of ammonia contains .8235 pounds of nitrogen.

Manufacturers very commonly express the amount of nitrogen in the equivalent of ammonia, probably for the reason that, expressed as ammonia, larger figures are obtained than would be, if expressed as nitrogen; and the fertilizers appear to farmers to contain more nitrogen. While this method is in accordance with legal requirements and is entirely fair on the part of the manufactures, *farmers should know that "nitrogen" and "ammonia" are not the same thing, since one pound of ammonia contains only about eight-tenths of a pound of nitrogen.*

PHOSPHORIC ACID.

When we use the term "phosphoric acid" in connection with the chemical analysis of fertilizers, we mean a compound containing phosphorus and oxygen, which compound is really not phosphoric acid at all and which could not well exist in fertilizers;

but chemists have, as a matter of convenience, adopted this form of statement. So, when the term "phosphoric acid" is used, it means simply the compound of phosphorus and oxygen known chemically as phosphorus pentoxide or phosphorus anhydride. *The numbers in the columns under* "PHOSPHORIC ACID" *state the amount of the phosphorus oxide above mentioned, that is equivalent to the phosphoric acid in the form of phosphates of lime (or calcium) actually existing in the fertilizer.*

In the analytical tables, the amount of phosphoric acid is stated under three different heads or forms—(1st) "Available" phosphoric acid, (2d) "Insoluble" phosphoric acid, and (3d) "Total" phosphoric acid. The "phosphoric acid" in these terms is used in the sense already explained.

1. *Available phosphoric acid.*

The figures in the column under "available" represent the amount of phosphoric acid that is present in the form of *soluble calcium phosphate,* plus the amount present in the form of *reverted calcium phosphate.* As explained in Bulletin 27, page 420, paragraphs 52 and 53, *soluble* calcium phosphate is formed by treating with sulphuric acid some form of insoluble calcium phosphate, such as bones, bone-ash, South Carolina rock, etc. The phosphate thus formed is readily *soluble* in water. This soluble phosphate, on standing, is, to some extent, changed into a less soluble form, which is still quite readily available as plant food. Since both the *soluble* and *reverted* forms of phosphates are *available as plant food,* we include in a statement of analysis under the head of "AVAILABLE" PHOSPHORIC ACID, *the phosphoric acid that is present in the forms of both soluble and reverted calcium phosphates.*

2. *Insoluble phosphoric acid.*

The figures in the column under "INSOLUBLE" PHOSPHORIC ACID *represent the amount of phosphoric acid that is present in the form of insoluble calcium phosphate.* This form is not soluble in water and is the least valuable form of phosphates.

3. *Total Phosphoric Acid.*

The figures in the column under "TOTAL" PHOSPHORIC ACID *represent the entire amount of phosphoric acid present in a fertilizer,* without regard to the form in which it exists. The total phosphoric acid is, therefore, the sum of the available and insoluble phosphoric acid.

POTASH.

The term "potash," as used in connection with the analysis of fertilizers, always means the compound containing potassium and oxygen, known as potassium oxide, though it originally meant the carbonate of potassium. Potash or potassium oxide is never found as such in fertilizers, but chemists use this form of expressing results of analysis as a convenient standard for reference. Fertilizers generally contain potash in such forms as sulphate of potash, chloride of potash or carbonate of potash; and *the figures in the column under* "DETERMINED AS POTASH" *represent the amount of actual potash (potassium oxide) that is equivalent to the sulphate, chloride or carbonate of potash present.* The "Potash soluble in water" represents the available potash and only this is determined. The forms of potash commonly present in commercial fertilizers such as the chloride, sulphate and carbonate, are readily soluble in water and are, therefore, available as plant food.

TOTAL CONSTITUENTS OF FERTILIZERS.

If we add together the figures representing the different constituents of a fertilizer (the nitrogen, the total phosphoric acid, and the potash), we shall find, as a rule, that the sum amounts to only twenty or thirty per cent. or pounds per hundred. The question often arises "Why does the sum of the constituents in the analysis of a fertilizer amount to only twenty or thirty per cent., and what is the remaining portion, amounting to seventy or eighty per cent. made up of?" A few illustrations will, perhaps, suffice to make the matter clear.

Taking, first, a high-grade fertilizer, we find by analysis that it contains three per cent. of nitrogen, eight per cent. of available phosphoric acid, two per cent. of insoluble phosphoric acid, and ten per cent. of potash. If the nitrogen comes from dried blood or meat, it will take about ten pounds of such material to furnish one pound of nitrogen. Since there are three per cent. of nitrogen, or three pounds of nitrogen in 100 pounds of fertilizer, it will take 30 pounds of dried blood to furnish this amount of nitrogen.

The amount of bone and sulphuric acid necessary to make a phosphate containing eight pounds of available phosphoric acid and two pounds of insoluble phosphoric acid would amount to about forty pounds. If the potash is present in the form of a sulphate, about eighteen and one-half pounds of pure sulphate would be required to be equivalent to ten pounds of potash. Tabulating the foregoing figures, we have the following:

	Pounds.
Dried blood required to furnish three pounds of nitrogen.....	30
Bone and sulphuric acid required to furnish phosphates containing eight pounds of available and two pounds of insoluble phosphoric acid....................................	40
Sulphate of potash (pure) equivalent to ten pounds of potash..	18½
Moisture and dirt..........................	11½
Total..	100

Taking a low grade fertilizer, we find by analysis that it contains 0.8 per cent. of nitrogen, eight per cent. of available phosphoric acid, 0.5 per cent. insoluble phosphoric acid and two per cent. of potash. Supposing the sources to be the same as in the previous case, we should have

	Pounds
Dried blood required to furnish 0.8 pounds of nitrogen.......	8
Bones, etc., required to furnish eight pounds of available and 0.5 pounds insoluble phosphoric acid.....................	37
Sulphate of potash (pure) equivalent to two pounds of potash,	3.7
Moisture, dirt, etc..	51.3
Total..	100

While the foregoing calculations would not be entirely accurate for many fertilizers, they serve to give a fair idea of what a hundred pounds of a fertilizer may be made up, and why the chemist's statement of analysis does not account for more than twenty or thirty pounds in 100 pounds.

XXIII. METHOD OF MAKING COMMERCIAL VALUATIONS OF FERTILIZERS.

PRICES OF NITROGEN, PHOSPHORIC ACID AND POTASH.

The following schedule of trade values is the one to be used in calculating the commercial value of fertilizers during the years of 1890 and 1891:

Trade-values of fertilizing ingredients in raw materials and chemicals, adopted by Experiment Station.

	1890. Cts. per pound.	1891. Cts. per pound.
Nitrogen in ammonia salts	17	18½
Nitrogen in nitrates	14½	14½
Organic nitrogen in dry and fine ground fish, meat and blood	17	15½
Organic nitrogen in cotton-seed meal and castor-pomace,	15	15
Organic nitrogen in fine ground bone and tankage	16½	15
Organic nitrogen in fine ground medium bone and tankage	13	12
Organic nitrogen in medium bone and tankage	10½	9½
Organic nitrogen in coarse bone and tankage	8½	7½
Organic nitrogen in hair, horn shavings and coarse fish scraps	8	7
Phosphoric acid, soluble in water	8	8
Phosphoric acid, soluble in ammonium citrate	7½	7½
Phosphoric acid in dry ground fish, fish-bone and tankage,	7	7
Phosphoric acid in fine medium bone and tankage	6	5½
Phosphoric acid in medium bone and tankage	5	4½
Phosphoric acid in coarse bone and tankage	4	3
Phosphoric acid in fine ground rock phosphate	2	2
Potash as high-grade sulphate, in forms free from muriates (chlorides), in ashes, etc	6	5½
Potash in kainit	4½	4½
Potash in muriate	4½	4½
Organic nitrogen in mixed fertilizers	17	15½
Insoluble phosphoric acid in mixed fertilizers	2	2

The trade-values in the foregoing schedule represent the average prices at which, in the six months preceding March, the respective ingredients, in the form of unmixed raw materials, could be bought at retail for cash in our large markets — Boston, New York and Philadelphia. These prices also correspond to the average wholesale prices for the six months preceding March, plus about twenty per cent. in case of goods for which there are wholesale quotations.

WHAT THE COMMERCIAL VALUATION OF A FERTILZER IS.

The commercial valuation of a fertilizer consists in estimating the approximate value or money-cost of the essential fertilizing constituents (nitrogen, phosphoric acid and potash) in one ton of fertilizer.

VALUATION AND COST OF FERTILIZERS.

The total cost (to the farmer) of a ton of commercial fertilizer may be regarded as being usually made of the following elements: (1) Retail cash cost, in the market, of unmixed trade materials; (2) cost of mixing; (3) cost of transportation; (4) storage, commissions to agents and dealers, selling on long credit, bad debts, etc. While the *total cost* of a fertilizer is made up of several different elements, a *commercial valuation* includes only the first of the elements entering into the total cost, that is, the retail cash cost, in the market, of unmixed raw materials.

VALUATION AND AGRICULTURAL VALUE.

The *agricultural value* of a fertilizer depends upon its *crop-producing power.* A commercial valuation does not necessarily have any relation to crop-producing value. For a particular soil and crop, a fertilizer of comparatively low commercial valuation may have a higher agricultural value than another fertilizer with a higher valuation; while for another crop on the same soil or the same crop on another soil, the reverse might be true.

HOW TO MAKE A COMMERCIAL VALUATION OF A FERTILIZER FROM A STATEMENT OF CHEMICAL ANALYSIS AS GIVEN BY THIS STATION.

1. *Nitrogen.*

Multiply the number representing the per cent. of nitrogen by fifteen and a half cents (the value adopted for organic nitrogen in mixed fertilizers). This will give the value in cents of the nitrogen in 100 pounds of fertilizers.

Example.— In No. 119, the per cent. of nitrogen found by analysis is 3.49; hence, $3.49 \times 15\frac{1}{2}$ cents=54 cents.

2. *Available phosphoric acid.*

Multiply the number representing the per cent. of available phosphoric acid by eight cents which will give the value, in cents, of the available phosphoric acid in 100 pounds of fertilizer.

Example.— In No. 119 the per cent. of available phosphoric acid is 13.21; hence, 13.21 × 8 cents=105.6 cents.

3. *Insoluble phosphoric acid.*

Multiply the number representing the per cent. of insoluble phosphoric acid by two cents, which will give the value, in cents, of the insoluble phosphoric acid in 100 pounds of fertilizer.

Example.—In No. 119, the per cent. of insoluble phosphoric acid is .43, hence .43 × 2 cents=.8 cents.

4. *Potash.*

Multiply the number representing the per cent. of potash by five and one-half cents (if the potash is known to be present in the form of sulphate or carbonate) or by four and one-half (if the potash is known to be present in the form of muriate (chloride), kainit, etc.). The result will be the value, in cents, of the potash present in 100 pounds of fertilizer.

Example.—In No. 119, the per cent. of potash is 2.92. As the analysis does not state the form in which the potash is present, we will assume that it is in the form of sulphate; hence 2.92 × 5½ cents=16 cents.

5. *Valuation of one ton of fertilizer.*

Add together the numbers representing the values, in cents, of nitrogen, available phosphoric acid, insoluble phosphoric acid and potash. The sum will give the value, in cents, of the fertilizing constituents in 100 pounds of fertilizer. Multiply this sum by twenty, which will give the value, in cents, of the fertilizing ingredients in one ton of fertilizer.

Example.— Taking No. 119 and the preceding values obtained, we have:

		Cents.
(1.) Nitrogen	3.49 × 15½ =	54.0
(2.) Available phosphoric acid	13.21 × 8 =	105.6
(3.) Insoluble phosphoric acid	0.43 × 2 =	0.8
(4.) Potash	2.92 × 5½ =	16.0
(5.) Total valuation of 100 pounds		176.4

(6.) Total valuation of 2,000 pounds or one ton

$$176.4 \text{ cents} \times 20 = \begin{cases} 3{,}528 \text{ cents or} \\ \$35.28. \end{cases}$$

HOW TO MAKE A COMMERCIAL VALUATION OF A FERTILIZER FROM A MANUFACTURER'S GUARANTEE-ANALYSIS.

The forms of statement used by manufacturers in giving guaranteed analyses differ considerably from one another; they also differ from the form of statement adopted by this Station, generally in the following respects:

(*a.*) The amount of each ingredient is stated as being between two limits varying more or less widely. Thus, in the guaranteed analysis of No. 119, ammonia equals three to four per cent.; available phosphoric acid equals ten to twelve per cent.; insoluble phosphoric acid equals one to three per cent.; potash equals two to three per cent. In making a valuation from such a form of statement of analysis, *the lower number is always to be used,* since the manufacturer is held by law only to the lower guarantee.

(*b*) The per cent. of nitrogen in the guarantee-analysis of manufacturers is generally given in the form of ammonia. In these fertilizer reports, both forms are given. When, as in most cases, the guarantee-analysis states only the amount of ammonia, its equivalent of nitrogen is calculated by us and given in the Station form of statement, though not given in the manufacturers' form of guarantee.

(*c*) The per cent. of potash is often given in the guarantee-analysis in the form of sulphate or muriate (chloride) of potash. In the Station form of statement, the manufacturer's guarantee is always made to give the actual potash.

In making valuations from guarantee-analyses as given in the Station reports, the same rule will be followed as given above, but when it is desired to use the manufacturers' actual statement of analysis as a basis for making a valuation, some modifications must be made in the foregoing rule.

1. *Nitrogen.*

If the amount of actual nitrogen is given, proceed as above under Station analysis. If nitrogen is stated only in form of ammonia, then multiply the lower numbers representing the per cent. of ammonia by .8235, which will give the per cent. of actual nitrogen; and this multiplied by fifteen and one-half cents will give the value of ammonia or its equivalent of nitrogen in 100 pounds of fertilizer.

Example.—In No. 119, the per cent. of ammonia, as given in the guarantee-analysis, is 3 to 4. Hence, 3 × .8235 = 2.47 per cent. nitrogen; 2.47 × $15\frac{1}{2}$ cents = 38 cents.

2. *Available and insoluble phosphoric acid.*

Use the lower number of the guarantee-analysis and proceed as in valuation from Station analysis given above.

3. *Potash.*

If the per cent. of actual potash is given, then proceed as above in valuation from Station analysis. If potash is given as sulphate, then multiply the per cent. of sulphate by .54, which will give the amount of actual potash equivalent to the sulphate. Multiply the number thus obtained by five and one-half cents. If the potash is given in the form of muriate (chloride), multiply the per cent. of muriate (chloride) by .63, and then multiply the result by four and one-half cents.

Example.—A fertilizer is guaranteed to contain "six to eight per cent. of potash as sulphate;" 6 × .54 = 3.24 per cent. of actual potash; 3.24 × $5\frac{1}{2}$ cents = 17.8 cents, the value of potash as sulphate in 100 pounds of fertilizer.

Example.—A fertilizer is guaranteed to contain five to seven per cent. of potash as muriate (chloride); 5 × .63 = 3.15 per cent. of actual potash; 3.15 × $4\frac{1}{2}$ cents = 14.1 cents, the value of the actual potash as muriate in 100 pounds of fertilizer.

4. *Valuation of one ton.*

Proceed as under valuation from Station analysis.

Example.—A guarantee analysis is as follows: Ammonia equals two to three per cent.; available phosphoric acid equals ten to twelve per cent.; insoluble phosphoric acid equals one to two per cent.; potash as sulphate equals five to six per cent.

	Cents.
(1.) 2 × .8235 = 1.64 per cent. actual nitrogen; 1.64 × $15\frac{1}{2}$ cents = value of nitrogen	25.4
(2.) 10 × 8 cents = value of available phosphoric acid	80.0
(3.) 1 × 2 cents = value of insoluble phosporic acid	2.0
(4.) 5 × .54 = 2.7 per cent. actual potash; 2.7 × $5\frac{1}{2}$ cents =	14.8
Total value of 100 pounds =	122.2

122.2 × 20 = 2,444 cents or \$24.44 per ton.

HOW TO MAKE A COMMERCIAL VALUATION OF SOME UNMIXED CHEMICALS.

1. *Sulphate of ammonia.*

Multiply the per cent. of ammonia by .8235 and then multiply the obtained result by eighteen and one-half cents (the price of one pound of nitrogen in the form of ammonia salts). Multiply the result by twenty.

Example. — A manufacturer guarantees the ammonium sulphate sold by him to contain twenty per cent. of ammonia.

.8235 × 20 = 16.47 per cent. of ammonia.

16.47 × $18\frac{1}{2}$ cents = 304 cents, the value of the nitrogen in 100 of ammonium in sulphate.

304 cents × 20 = 6,080 cents or $60.80 per ton.

2. *Sulphate of potash.*

Multiply the guaranteed per cent. of sulphate of potash by .54 and the result by five and a half and the product by twenty.

Example.—A manufacturer guarantees his product to contain forty per cent. of sulphate of potash; .54 × 40 = 21.6 per cent. of actual potash; 21.6 × $5\frac{1}{2}$ = 118.8 cents, the value of actual potash in 100 pounds of sulphate.

118.8 cents × 20 = 2,376 cents or $23.76 per ton.

3. *Muriate (chloride) of potash.*

Multiply the per cent. of muriate guaranteed by .63; then this result by four and one-half cents, and this product by twenty.

4. *Nitrate of soda.*

Multiply the guaranteed per cent. of nitrate of soda by 16.47 to find the per cent. of nitrogen. Multiply the per cent. of nitrogen by fourteen and one-half cents (the value of one pound of nitrogen in the form of nitrates), then multiply the last result by twenty to get the value of one ton.

As a matter of convenience for reference, there are given below in brief form the methods already used in converting one chemical compound into an equivalent of some other chemical compound :

(1.) To change ammonia into an equivalent amount of nitrogen, multiply amount of ammonia by .8235
(2.) To change nitrogen into an equivalent amount of ammonia, multiply amount of nitrogen by 1.214
(3.) To change muriate (chloride) of potash into an equivalent amount of actual potash, multiply amount of muriate by .63
(4.) To change actual potash into an equivalent amount of muriate (chloride) of potash, multiply amount of actual potash by 1.585
(5.) To change sulphate of potash into an equivalent amount of actual potash, multiply amount of sulphate by .54
(6.) To change actual potash into an equivalent amount of sulphate of potash, multiply amount of actual potash by 1.85

XXIV. TABULATED STATEMENT OF FERTILIZING COMPOSITION AND VALUATION OF VARIOUS PRODUCTS.

For convenience as a present and future reference, it is considered desirable to present a rather full compilation of the analyses of various commercial fertilizing materials and of various farm products, giving their fertilizing constituents and valuation.

There are many other farm products which it would be desirable to present in these tables, but their omission is rendered necessary by reason of the fact that there have yet been made no complete analyses of their fertilizing constituents. This Station purposes in the near future to make such analyses as will fill up many of these gaps. The analyses presented have been compiled from every accessible, reliable source, such as the reports of various experiment stations, standard works upon agriculture, and, especially, Koenig's invaluable compilation.

In making out the following tables, the following prices *in cents per pound* have been fixed in accordance with the trade value of the various ingredients adopted for the year 1891: Nitrogen in ammonia compounds and in urine of animals, eighteen and one-half; nitrogen in nitrates, fourteen and one-half; organic nitrogen in animal matter, as fine ground fish, meat, blood, and solid excrements, fifteen and one-half; organic nitrogen in vegetable matter, fifteen; organic matter in hair, horn, etc., seven and one-half; phosphoric acid, soluble in water, eight; phosphoric acid, "reverted," seven and one-half; phosphoric acid in dry ground fish, fine bone and tankage, seven; phosphoric acid in other forms of organic matter, five and one-half; phosphoric acid, insoluble forms, two; potash, in form of sulphate, in ashes, etc., five and one-half; potash in chlorides, in kainit, in vegetable and animal matter, four and one-half.

1. COMMERCIAL FERTILIZING MATERIALS.

A. Materials containing phosphates.

NAME OF SUBSTANCE.	Moisture.	Nitrogen.	Potash.	Phosphoric Acid.			Valuation per ton of 2,000 pounds.
				Available.	Insoluble.	Total.	
Apatite	......	......	......	......	......	36.08	$14 43
Bone ash	7.00	......	......	......	......	35.80	14 35
Bone black	4.60	......	......	......	......	29.28	11 31
Bone black (dissolved)	......	......	......	16.70	0.30	17.00	26 84
Bone meal	7.47	4.12	......	8.28	15.22	23.50	42 35
Bone meal (free from fat)	......	6.20	......	......	......	20.10	40 71
Bone meal (from glue factory)	......	1.70	......	......	......	29.90	37 99
Bone meal (dissolved)	......	2.60	......	13.53	4.07	17.60	33 92
Carribean guano	......	......	......	......	......	18.90	7 56
Cuba guano	24.27	1.67	......	......	......	13.35	10 35
Keystone condensed phosphate	1.50	......	......	38.81	8.94	47.75	65 67
Mona Island guano	12.52	0.76	......	7.55	14.33	21.88	20 09
Navassa phosphate	7.60	......	......	......	......	34.27	13 71
Orchilla guano	7.31	......	......	......	......	26.77	10 71
Peruvian guano	14.81	7.85	2.61	8.36	6.90	15.26	42 56
South Carolina rock (ground)	1.50	......	......	0.60	27.43	28.03	11 93
South Carolina rock (floats)	......	......	......	......	......	27.20	10 88
South Carolina rock (dissolved)	......	......	......	11.60	3.60	15.20	20 00
Thomas Slag (American)	......	......	......	......	......	21.37	8 55
Thomas Slag (English)	......	......	......	6.09	13.31	19.40	15 07
Thomas Slag (German)	......	......	......	......	......	30.51	12 20

COMMERCIAL FERTILIZING MATERIALS — (*Concluded*).

B. Materials containing potassium.

NAME OF SUBSTANCE.	Moisture.	Nitrogen.	Potash.	PHOSPHORIC ACID.			Valuation per ton of 2,000 pounds.
				Available.	Insoluble.	Total.	
Carnallite	......	......	13.68	......	......	......	$12 31
Cotton-seed hull ashes	7.33	......	23.80	......	......	8.50	29 58
Kainite	3.20	......	13.54	......	......	......	12 19
Krugite	4.82	......	8.42	......	......	......	7 58
Muriate of potash	2.00	......	52.46	......	......	......	47 21
Nitrate of potash	1.93	13.09	45.19	......	......	......	87 67
Spent tan-bark ashes	6.31	......	2.04	......	......	1.61	2 89
Sulphate of potash (high grade)	1.25	......	38.60	......	......	......	42 46
Sulphate of potash and magnesia	4.75	......	23.50	......	......	......	25 85
Sylvinite	7.25	......	16.65	......	......	......	14 98
Waste from gunpowder works	2.75	2.43	18.00	......	......	......	26 85
Wood ashes (unleached)	12.00	......	5.50	......	......	1.85	6 79
Wood ashes (leached)	......	......	1.10	......	......	1.40	1 77

C. Materials containing nitrogen.

NAME OF SUBSTANCE.	Moisture.	Nitrogen.	Potash.	PHOSPHORIC ACID.			Valuation per ton of 2,000 pounds.
				Available.	Insoluble.	Total.	
Ammonite	5.88	11.33	......	......	......	3.43	38 90
Castor pomace	9.98	5.56	1.12	......	......	2.16	20 06
Cotton-seed meal	6.80	6.66	1.62	......	......	1.45	23 03
Dried blood	12.50	10.52	......	......	......	1.91	34 71
Dried fish	12.75	7.25	0.45	3.05	5.20	8.25	33 48
Horn and hoof waste	10.17	13.25	......	......	......	1.83	43 09
Lobster shells	7.27	4.50	......	......	......	3.52	17 82

Meat scrap	12.09	10.44	......	......	......	2.07	34 64
Oleomargarine refuse	8.54	12.12	......	......	......	0.88	38 54
Sulphate of ammonia	1.00	20.50	......	......	......	......	75 85
Tankage	13.20	6.82	......	5.02	6.23	11.25	36 03
Tobacco stems	10.61	2.29	6.44	......	......	0.60	13 33
Wool waste	9.27	5.64	1.30	......	......	0.29	18 41
D. Miscellaneous materials.							
Ashes (anthracite coal)	......	......	0.10	......	......	0.10	0 13
Ashes (bituminous coal)	......	......	0.40	......	......	0.40	0 52
Ashes (lime-kiln)	15.45	......	0.86	......	......	1.18	1 25
Marls (Massachusetts)	18.18	......	......	......	......	1.05	0 42
Marls (North Carolina)	1.50	......	0.04	......	......	0.56	0 26
Marls (Virginia)	15.98	......	0.49	......	......	0.09	0 48
Mud (fresh water)	40.37	1.37	0.22	......	......	0.26	4 41
Peat	61.50	0.75	......	......	......	......	2 25
Soot	5.54	......	1.83	......	......	......	2 01
Turf	19.29	1.94	......	......	......	......	5 82

2. FERTILIZING CONSTITUENTS IN FARM PRODUCTS.

A. Farm manures.

NAME OF SUBSTANCE.	Moisture.	Nitrogen.	Potash.	Phosphoric acid.	Valuation per ton of 2,000 pounds.
Cattle (solid fresh excrement)	.....	0.29	0.10	0.17	$1 18
Cattle (fresh urine)	.....	0.58	0.49	.....	2 59
Hen manure (fresh)	.....	1.63	0.85	1.54	7 51
Horse (solid fresh excrement)	.....	0.44	0.35	0.17	1 87
Horse (fresh urine)	.....	1.55	1.50	.....	7 09
Human excrement (solid)	77.20	1.00	0.25	1.09	4 52
Human urine	95.90	0.60	0.20	0.17	2 67
Poudrette (night soil)	.....	0.80	0.30	1.40	4 29
Sheep (solid fresh excrement)	.....	0.55	0.15	0.31	2 18
Sheep (fresh urine)	.....	1.95	2.26	0.01	9 27
Stable manure (mixed)	73.27	0.50	0.60	0.30	2 42
Swine (solid fresh excrement)	.....	0.60	0.13	0.41	2 43
Swine (fresh urine)	.....	0.43	0.83	0.07	2 45

B. Hay and dry coarse fodders.

NAME OF SUBSTANCE.	Moisture.	Nitrogen.	Potash.	Phosphoric acid.	Valuation per ton of 2,000 pounds.
Blue melilot	8.22	1.92	2.80	0.54	8 87
Buttercups	.....	1.02	0.81	0.41	4 24
Carrot tops (dry)	9.76	3.13	4.88	0.61	14 46
Clover (alsike)	9.93	2.33	2.01	0.70	9 57
Clover (Bokhara)	6.36	1.77	1.67	0.44	7 30
Clover (mammoth red)	11.41	2.23	1.22	0.55	8 39
Clover (medium red)	10.72	2.09	2.20	0.44	8 73
Clover (white)	.....	2.75	1.81	0.52	10 45
Corn fodder	.....	1.80	0.76	0.51	6 65
Corn stover	28.24	1.12	1.32	0.30	4 88
Cow-pea vines	9.00	1.64	0.91	0.53	6 32
Daisy (white)	9.65	0.28	1.25	0.44	2 45
Daisy (ox eye)	.....	0.80	2.23	0.27	4 70
Hungarian grass	7.15	1.16	1.28	0.35	5 02
Italian rye-grass	8.29	1.15	0.99	0.55	4 95
June grass	.....	1.05	1.46	0.37	4 87
Lucerne (alfalfa)	6.26	2.07	1.46	0.53	8 11
Meadow fescue	9.79	0.94	2.01	0.34	5 00
Meadow foxtail	.....	1.54	2.19	0.44	7 08
Mixed grasses	11.26	1.37	1.54	0.35	5 88
Orchard grass	8.84	1.31	1.88	0.41	6 07
Perennial rye-grass	9.13	1.23	1.55	0.56	5 70
Red-top	7.71	1.15	1.02	0.36	4 76
Rowen	12.48	1.75	1.97	0.46	7 53
Salt hay	5.36	1.18	0.72	0.25	4 46
Serradella	7.39	2.70	0.65	0.78	9 54
Soja bean	6.30	2.32	1.08	0.67	8 67

2. FERTILIZNG CONSTITUENTS IN FARM PRODUCTS — (*Continued*).

B. Hay and dry coarse fodders — (Concluded).

NAME OF SUBSTANCE.	Moisture.	Nitrogen.	Potash.	Phosphoric acid.	Valuation per ton of 2,000 pounds.
Tall meadow oat	.....	1.16	1.72	0.32	$5 38
Timothy hay	7.52	1.26	1.53	0.46	5 66
Vetch and oats	11.98	1.37	0.90	0.53	5 50
Yellow trefoil	.....	2.14	0.98	0.43	7 78
C. Green fodders.					
Buckwheat	82.60	0.51	0.43	0.11	2 04
Clover (red)................	80.00	0.53	0.46	0.13	2 15
Clover (white)..............	81.00	0.56	0.24	0.20	2 12
Corn fodder................	72.64	0.56	0.62	0.28	2 55
Corn fodder (ensilage)	71.60	0.36	0.33	0.14	1 53
Cow-pea vines..............	78.81	0.27	0.31	0.98	2 17
Horse bean	74.71	0.68	1.37	0.33	3 64
Lucerne (alfalfa)............	75.30	0.72	0.45	0.15	2 73
Meadow grass (in flower)....	70.00	0.44	0.60	0.15	2 03
Millet	62.58	0.61	0.41	0.19	2 41
Oats (green)	83.36	0.49	0.38	0.13	1 96
Peas	81.50	0.50	0.56	0.18	2 20
Prickley comfrey	.....	0.42	0.75	0.11	2 06
Rye grass..................	70.00	0.57	0.53	0.17	2 37
Serradella	82.59	0.41	0.42	0.14	1 76
Sorghum	....	0.40	0.32	0.08	1 58
Spanish moss	60.80	0.28	0.26	0.30	1 40
Vetch and oats	86.11	0.24	0.79	0.09	1 53
White lupine...............	85.35	0.44	1.73	0.35	3 26
Young grass	80.00	0.50	1.16	0.22	2 79
D. Straw, chaff, leaves, etc.					
Barley chaff................	13.08	1.01	0.99	0.27	4 22
Barley straw	13.25	0.72	1.16	0.15	3 37
Bean shells	18.50	1.48	1.38	0.55	6 29
Beech leaves (autumn)......	15.00	0.80	0.30	0.24	2 93
Buckwheat straw...........	16.00	1.30	2.41	0.61	6 74
Cabbage leaves (air-dried)...	14.60	0.24	1.71	0.75	3 08
Cabbage stalks (air-dried)...	16.80	0.18	3.49	1.06	4 85
Carrots (stalks and leaves)...	80.80	0.51	0.37	0.21	2 09
Corn cobs..................	12.09	0.50	0.60	0.06	2 11
Corn hulls	11.50	0.23	0.24	0.02	0 93
Hops	11.07	2.53	1.99	1.75	11 31
Oak leaves.................	15.00	0.80	0.15	0.34	2 91
Oat chaff..................	14.30	0.64	1.04	0.20	3 08
Oat straw..................	28.70	0.29	0.88	0.11	1 78
Pea shells	16.65	1.36	1.38	0.55	5 93
Pea straw (cut in bloom)	.....	2.29	2.32	0.68	9 71
Pea straw (ripe)	.....	1.04	1.01	0.35	4 41

FERTILIZING CONSTITUENTS IN FARM PRODUCTS — (*Continued*).

D. Straw, chaff, leaves, etc. — (Concluded).

NAME OF SUBSTANCE.	Moisture.	Nitrogen.	Potash.	Phosphoric acid.	Valuation per ton of 2,000 pounds.
Potato stalks and leaves	77.00	0.49	0.07	0.06	$1 60
Rye straw	15.40	0.24	0.76	0.19	1 61
Sugar-beet stalks and leaves	92.65	0.35	0.16	0.07	1 27
Turnip stalks and leaves	89.80	0.30	0.24	0.13	1 33
Wheat chaff (spring)	14.80	0.91	0.42	0.25	3 38
Wheat chaff (winter)	10.56	1.01	0.14	0.19	3 37
Wheat straw (spring)	15.00	0.54	0.44	0.18	2 21
Wheat straw (winter)	10.36	0.82	0.32	0.11	2 87
E. Roots, tubers, etc.					
Beets (red)	87.73	0.24	0.44	0.09	1 22
Beets (sugar)	84.65	0.25	0.29	0.08	1 10
Beets (yellow fodder)	90.60	0.19	0.46	0.09	1 08
Carrots	90.02	0.14	0.54	0.10	1 02
Mangolds	87.29	0.19	0.38	0.09	1 01
Potatoes	79.75	0.21	0.29	0.07	97
Ruta bagas	87.82	0.21	0.50	0.13	1 22
Turnips	87.20	0.22	0.41	0.12	1 16
F. Grains, and other seeds.					
Barley	15.42	2.06	0.73	0.95	7 88
Beans	.....	4.10	1.20	1.16	14 66
Buckwheat	14 10	1.44	9.21	0.44	4 99
Corn kernels	10.88	1.82	0.40	0.75	6 59
Corn kernels and cobs (cob-meal)	10.00	1.46	0.44	0.60	5 44
Hempseed	12.20	2.62	0.97	1.75	10 66
Linseed	11.80	3.20	1.04	1.30	11 97
Lupines	13.80	5.52	1.14	0.87	18 54
Millet	13.00	2.40	0.47	0.91	8 62
Oats	20.80	1.75	0.41	0.48	6 15
Peas	19.10	4.26	1.23	1.26	15 27
Rye	14.90	1.76	0.54	0.82	6 67
Soja beans	18.33	5.30	1.99	1.87	19 75
Sorghum	14.00	1.48	0.42	0.81	5 71
Wheat (spring)	14.75	2.36	0.61	0.89	8 61
Wheat (winter)	15.40	2.83	0.50	0.68	9 69
G. Flour and meal.					
Corn meal	13.52	2,05	0.44	0.71	7 33
Ground barley	13.43	1.55	0.34	0.66	5 68
Hominy feed	8.93	1.63	0.49	0.98	7 11
Pea meal	8.85	3.08	0.99	0.82	11 03
Rye flour	14.20	1.68	0.65	0.85	6 56
Wheat flour	9.83	2.21	0.54	0.57	7 74

Fertilizing Constituents in Farm Products — (*Continued*).

H. By-products and refuse.

NAME OF SUBSTANCE.	Moisture.	Nitrogen.	Potash.	Phosphoric acid.	Valuation per ton of 2,000 pounds.
Apple pomace	80.50	0.23	0.13	0.02	$0 83
Cotton hulls	10.63	0.75	1.08	0.18	3 42
Cotton-seed meal	.....	6.52	1.89	2.78	24 32
Glucose refuse	8.10	2.62	0.15	0.29	8 31
Gluten meal	8.53	5.43	0.05	0.43	16 81
Hop refuse	8.98	0.98	0.11	0.20	3 26
Linseed cake (new process)	6.12	5.40	1.16	1.42	18 81
Linseed cake (old process)	7.79	6.02	1.16	1.65	20 92
Malt sprouts	10.28	3.67	1.60	1.40	13 99
Oat bran	8.19	2.25	0.66	1.11	8 57
Rye middlings	12.54	1.84	0.81	1.26	7 64
Spent brewer's grains (dry)	6.98	3.05	1.55	1.26	11 93
Spent brewer's grains (wet)	75.01	0.89	0.05	0.31	3 06
Wheat bran	11.01	2.88	1.62	2.87	13 26
Wheat middlings	9.18	2.63	0.63	0.95	9 50
I. Dairy products.					
Milk	87.20	0.58	0.17	0.30	2 28
Cream	68.80	0.58	0.09	0.15	2 04
Skim-milk	90.20	0.58	0.19	0.34	2 34
Butter	13.60	0.12	.....	.....	0 37
Buttermilk	90.10	0.64	0.09	0.15	2 23
Cheese (from unskimmed milk)	38.00	4.05	0.29	0.80	13 70
Cheese from half-skimmed milk)	39.80	4.75	0.29	0.80	15 87
Cheese (from skimmed milk)	46.00	5.45	0.20	0.80	17 96
J. Flesh of farm animals.					
Beef	77.00	3.60	0.52	0.43	11 74
Calf (whole animal)	66.20	2.50	0.24	1.38	9 23
Ox	59.70	2.66	0.17	1.86	10 18
Pig	52.80	2.00	0.90	0.44	7 02
Sheep	59.10	2.24	0.15	1.23	8 97
K. Garden products.					
Asparagus	.....	0.32	0.12	0.09	1 17
Cabbage	.....	0.30	0.43	0.11	1 41
Cucumbers	.....	0.16	0.24	0.12	0 83
Lettuce	.....	0.20	0.25	0.11	0 95
Onions	.....	0.27	0.25	0.13	1 18

XXV. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS

Composition of fertilizers as guaranteed by manufacturers, and

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Allentown Manufacturing Co., Allentown, Pa.	Lehigh phosphate.	Attica.	618
Armour & Co., Chicago, Ill.	Dried blood.	Syracuse.	36
H. J. Baker & Bro., New York city.	AA. Ammoniated super-phosphate.	Newburgh.	430
Bowker Fertilizer Co., Boston and New York.	Ammoniated dissolved bone phosphate.	Livonia Station. East Avon. Delhi.	313 318 411
Bowker Fertilizer Co., Boston and New York.	Hill and drill.	Canandaigua. East Avon. Delhi.	167 317 412
Bowker Fertilizer Co., Boston and New York.	Stockbridge for roots.	Syracuse.	10
Bowker Fertilizer Co., Boston and New York.	Stockbridge for vines.	Syracuse.	11
Bowker Fertilizer Co., Boston and New York.	Super-phosphate	Syracuse.	1 9 26
Bowker Fertilizer Co., Boston and New York.	Super-phosphate with potash.	Alfred Center. Cuba.	577 637
Bowker Fertilizer Co., Boston and New York.	Sure crop.	Canandaigua. Livonia Station. Geneseo.	168 314 344
Bradley Fertilizer Co., Boston, Mass.	Alkaline bone.	Seneca Castle.	173
Bradley Fertilizer Co., Boston, Mass.	Ammoniated dissolved bones	Canandaigua. Victor. Lima. Mt. Morris.	261 169 303 334
Bradley Fertilizer Co., Boston, Mass.	Circle extra fine ground bone with potash.	Hamden.	416
Bradley Fertilizer Co., Boston, Mass.	Dissolved bone.	Blood's Depot.	554

IN NEW YORK STATE FOR THE FALL OF 1890.

as found by chemical analysis — estimated in parts per hundred.

	Nitrogen.		Phosphoric Acid.			Potash, soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed	0.83	1.00	7 to 8	1 to 2	8 to 10	2 to 2.50
Found.	1.35	1.63	7.00	3.25	10.25	2.62
Guaranteed	12.76	15.50	....	....	....	....
Found.	13.08	15.88	....	....	....	....
Guaranteed	2.50 to 3.30	3 to 4	10 to 12	1 to 3	11 to 13	2 to 3
Found.	3.35	4.06	13.17	0.25	13 42	4.46
Guaranteed	1.65 to 2.50	2 to 3	8 to 10	2	10 to 12	1 to 2
Found.	2.10	2.54	9.85	1.85	11.70	2.47
Guaranteed	2 to 2.90	2.50 to 3.50	8 to 10	2	10 to 12	2 to 3
Found.	2.22	2.70	9.49	2.43	11.52	2.66
Guaranteed	2.5 to 3.30	3 to 4	9 to 11	....	....	2 to 4
Found.	2.66	3.22	9.59	1.54	11.13	3.92
Guaranteed	3.30 to 4.10	4 to 5	7 to 8	1 to 2	8 to 10	5 to 6
Found.	3.16	3.84	9.66	1.85	11.51	5.26
Guaranteed	....	....	10 to 12	2	12 to 14	1 to 2
Found.	....	....	10.31	1.58	11.89	2.71
Guaranteed	....	....	10 to 12	2	12 to 14	1 to 2
Found.	....	....	12.05	2.96	15.01	1.22
Guaranteed	0.83 to 1.65	1 to 2	8 to 10	2	10 to 12	1 to 2
Found.	1.05	1.30	8.78	2.74	11.52	1.45
Guaranteed	....	....	11 to 15	1 to 2	12 to 16	2.40 to 3.50
Found.	....	....	10.54	1.99	12.53	2.52
Guaranteed	1.65 to 2.50	2 to 3	7 to 9	1 to 2	8 to 10	1 to 2
Found.	2.63	2.46	9.90	1.55	11.45	1.81
Guaranteed	1.85 to 2.70	2.25 to 3.25	8 to 12	1 to 2	10 to 13	2 to 3
Found.	2.19	2.66	8.99	1.50	10.49	3.41
Guaranteed	....	....	12 to 15	1 to 2	13 to 16	....
Found.	....	....	14.75	1.05	15.70	....

XXV. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bradley Fertilizer Co., Boston, Mass.	Dissolved bone with potash.	Penn Yan.	273
Bradley Fertilizer Co., Boston, Mass.	Eureka superphosphate.	Avon.	319
Bradley Fertilizer Co., Boston, Mass.	Farmer's new method.	Canandaigua.	171
Bradley Fertilizer Co., Boston, Mass.	Fine ground bone.	Attica.	620
Bradley Fertilizer Co., Boston, Mass.	Niagara phosphate.	Lima.	302
Bradley Fertilizer Co., Boston, Mass.	Bradley's patent super-phosphate.	Milo Center. Victor. Moscow.	284 260 331
Bradley Fertilizer Co., Boston, Mass.	Potato fertilizer.	Delhi.	407
Bradley Fertilizer Co., Boston, Mass.	Bradley's sea fowl guano.	Canandaigua.	170
Chemical Co. of Canton, Baltimore, Md.	Dissolved bone phosphate.	Lyons. Weedsport.	45 67
Chesapeake Guano Co., Baltimore, Md.	Oriole alkaline bone.	Lima.	304
Cleveland Dryer Co., Cleveland, Ohio.	Ohio seed maker	York.	330
Cleveland Dryer Co., Cleveland, Ohio.	Square bone.	Hamburgh.	674
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Acidulated bone black.	Buffalo.	657
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated bone superphosphate.	Arcade. Hornellsville. Springville.	632 574 653
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated bone superphosphate.	Hart Lot.	53

FERTILIZERS, ETC.— (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash, soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed Found.	0.83 to 1.65 1.18	1 to 2 1.44	8 to 10 9.22	1 to 2 1.74	10 to 12 10.96	4 to 6 4.07
Guaranteed Found.	....	....	9 to 12 11.33	.... 0.85	.... 12.18	3.20 to 4.30 2.99
Guaranteed Found.	0.83 to 1.65 1.50	1 to 2 1.82	8 to 10 9.19	1 to 2 0.83	11 to 12 10.02	2.15 to 3.25 2.43
Guaranteed Found.	2.50 to 3.25 3.49	3 to 4 4.23	.... 7.30	.... 15.68	21 to 23 22.98	....
Guaranteed Found.	1 to 2 1.37	1.20 to 2.40 1.66	7 to 9 9.10	1 to 2 1.73	8 to 10 10.83	1 to 1.60 1.30
Guaranteed Found.	2.05 to 2.90 1.93	2.50 to 3.50 2.34	8 to 10 10.17	1 to 2 1.46	10 to 12 11.63	1.50 to 2.50 2.20
Guaranteed Found.	2.05 to 2.90 2.15	2.50 to 3.50 2.61	9 to 10 9.29	1 to 2 0.73	11 to 12 10.02	3.20 to 4.30 3.45
Guaranteed Found.	2.05 to 2.85 1.89	2.5 to 3.5 2.29	8 to 10 10.41	1 to 2 1.81	10 to 12 12.22	1.5 to 2.5 2.53
Guaranteed Found.	....	....	12 to 14 11.65	2 to 4 2.17	14 to 18 13.82	....
Guaranteed Found.	....	....	10 to 11 10.14	.... 0.53	.... 10.67	3 to 4 3.65
Guaranteed Found.	1.25 to 2.05 1.10	1.5 to 2.5 1.34	10 to 12 11.62	3 to 5 2.53	15 to 17 14.15	....
Guaranteed Found.	2.50 to 3.25 2.74	3 to 4 3.33	8 to 10 9.27	.... 2.45	.... 11.72	....
Guaranteed Found.	....	....	16 to 18 17.47	.... 0.76	.... 18.23	....
Guaranteed Found.	2.90 to 3.70 2.83	3.50 to 4.50 3.44	8 to 12 8.63	1 to 2 3.51	10 to 12 12.14	1 to 2 1.71
Guaranteed Found.	2.90 to 3.70 2.91	3.5 to 4.5 3.53	8 to 12 9.70	1 to 2 1.14	10 to 12 10.84	1.10 to 1.60 2.19

XXV. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Dissolved bone black.	Hopewell.	175
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	New rival ammoniated superphosphate.	Blood's Depot.	556
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Potato, hop and tobacco phosphate.	Alfred Center. Castile. Buffalo.	580 605 656
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Queen city phosphate.	Corning.	570
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Queen city phosphate.	Delhi.	409
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Wheat and corn phosphate.	Buffalo.	655
Davidge Fertilizing Co., New York city.	Wheat and corn compound.	Blood's Depot.	558
E. Frank Coe, New York city.	Alkaline bone.	Wyoming.	600
E. Frank Coe., New York city.	Alkaline bone.	Caledonia.	327
E. Frank Coe, New York city.	Ammoniated bone superphosphate.	Wyoming.	601
E. Frank Coe, New York city.	Gold brand excelsior guano.	Orient, L. I.	507
E. Frank Coe, New York city.	Muriate of potash.	Orient, L. I.	508
E. Frank Coe, New York city.	Red brand excelsior guano.	Orient, L. I.	506
E. Frank Coe, New York city.	XXV ammoniated bone super phosphate.	Benton Center.	252
Ellsworth, Tuttle & Co., Promised Land, L. I.	Ground fish scrap.	Promised Land.	510

FERTILIZERS, ETC.—(*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash, soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed Found.	....	....	15 to 18 16.72	....	....	....
Guaranteed Found.	1.25 to 2.05 1.39	1.50 to 2.50 1.68	10 to 12 10.77	1 to 3 1.26	11 to 13 11.03	1.60 to 2.70 3.01
Guaranteed Found.	2.05 to 2.90 2.37	2.50 to 3.50 2.88	10 to 12 9.53	1 to 2 1.27	.... 10.78	3.50 to 4.50 4.63
Guaranteed Found.	1.65 to 2.05 1.86	2 to 2.50 2.25	8 to 12 9.48	1 to 2 0.87	.... 10.35	1.10 to 2.15 2.61
Guaranteed Found.	1.65 to 2,05 1.78	2 to 2.50 2.16	8 to 12 8.54	1 to 2 1.45	9 to 12 9.99	1.08 to 2.16 2.21
Guaranteed Found.	2.05 to 2.90 2.44	2.50 to 3.50 2.96	10 to 13 12.50	1 to 2 3.75	.... 16.30	1.60 to 2.70 2.67
Guaranteed Found.	0.83 to 1.65 1.15	1 to 2 1.39	7 to 9 7.65	1 to 3 2.52	8 to 12 10.17	1 to 2 2.14
Guaranteed Found.	0.83 to 1.65 1.43	1 to 2 1.73	9 to 12 11.03	2 to 3 1.86	.... 12.89	1.60 to 2.15 2.45
Guaranteed Found.	1 to 1.50 1.09	1.20 to 1.80 1.32	9 to 12 10.94	2 to 3 1.34	11 to 14 12.28	1.60 to 2.15 1.94
Guaranteed Found.	1.75 to 2.00 1.92	2 to 2.50 2.33	8 to 10 10.50	.... 2.47	.... 12.97	1.10 to 1.60 1.84
Guaranteed Found.	2.50 to 3.25 3.20	3 to 4 3.88	8 to 10 8.57	1 to 2 1.25	8 to 11 9.82	6 to 8 5.59
Guaranteed Found.	....	....	....	....	....	52.44 54.03
Guaranteed Found.	3.30 to 4.10 4.13	4 to 5 5.02	7 to 9 9.27	1 to 2 0.52	10 to 12 9.79	6 to 7 5.65
Guaranteed Found.	0.83 to 1.23 0.70	1 to 1.05 0.85	7 to 9 11.17	2 to 3 1.91	10 to 12 12.08	1.50 to 2.25 1.60
Guaranteed Found.	8.23 9.59	10 11.63	.... 5.12	.... 0.42	6 5.54	....

XXV. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number
Ellsworth, Tuttle & Co., Promised Land, L. I.	No. 1.	Promised Land.	511
Farmers' Fertilizer Co., Syracuse, N. Y.	Empire guano.	De Witt.	41
Farmers' Fertilizer Co., Syracuse, N. Y.	Onondaga chief.	Attica. Perry Center.	626 610
Farmers' Fertilizer Co., Syracuse, N. Y.	Reaper brand.	De Witt.	37
Farmers' Fertilizer Co., Syracuse, N. Y.	Standard ammoniated bone phosphate.	Attica. Perry Center.	627 609
Farmers' Fertilizer Co., Syracuse, N. Y.	Standard ammoniated bone phosphate.	Shortsville. Penn Yan. N. Bloomfield.	163 274 301
Farmers' Fertilizer Co., Syracuse, N. Y.	Standard ammoniated bone phosphate, special formula.	De Witt.	40
Great Eastern Fertilizer Co., New York city.	Universal plant food.	Caledonia.	325
Great Eastern Fertilizer Co., New York city.	Wheat special.	Caledonia.	326
Listers' Ag'l Chemical Works, Newark, N. J.	Ammoniated dissolved bone.	Stanley.	188
Listers' Ag'l Chemical Works, Newark, N. J.	Ammoniated dissolved bone.	Newburgh.	433
Listers' Ag'l Chemical Works, Newark, N. J.	Bone flour.	Elmira.	203
Listers' Ag'l Chemical Works, Newark, N. J.	Dissolved bone-black.	Weedsport. E. Bloomfield.	48, 70 255
Listers' Ag'l Chemical Works, Newark, N. J.	Dried blood.	Weedsport.	47, 73
Listers' Ag'l Chemical Works, Newark, N. J.	German potash salts.	Weedsport.	46, 69

FERTILIZERS, ETC. — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed	4.10	5	....	....	8.00	10.00
Found.	4.59	5.66	7.48	0.22	7.70	12.00
Guaranteed	....	....	6 to 7.5	1 to 2	7.5 to 9	2.15 to 3.25
Found.	....	....	7.79	0.85	8.64	4.07
Guaranteed	0.83 to 2.05	1 to 2.50	7 to 9	1 to 2	8 to 11	2.15 to 3.25
Found.	0.96	1.16	8.17	1.10	9.27	3.19
Guaranteed	1.65 to 2.50	2 to 3	5.5 to 7	1 to 2	7.5 to 9	4.30 to 5.40
Found.	1.54	1.87	5.86	0.53	6.39	5.23
Guaranteed	0.83 to 1.65	1 to 2	9 to 11	2	11 to 13	3.25 to 4.30
Found.	1.01	1.22	8.73	0.83	9.56	3.70
Guaranteed	0.83 to 1.65	1 to 2	9 to 11	1 to 2	11 to 13	3.25 to 4.30
Found.	1.72	2.09	9.05	0.54	9.59	4.70
Guaranteed	0.83 to 1.65	1 to 2	8 to 10	1 to 2	10 to 12	2.15 to 3.25
Found.	0.82	0.99	8.08	0.94	9 02	2.86
Guaranteed	1 to 1.65	1.25 to 2	8 to 12	1 to 2	10 to 12	1.90 to 2.70
Found.	1.49	1.82	8.81	1.35	10.16	2.35
Guaranteed	1.65 to 2.05	2 to 2.50	8 to 12	1 to 3	10 to 12	1.60 to 2.70
Found.	1.32	1.60	8.71	1.15	9.86	2.78
Guaranteed	1.80 to 2.05	2.2 to 2.5	9 to 10	2 to 3	10 to 12	1.5 to 2
Found.	1.97	2.39	9.28	1.71	10.99	1.62
Guaranteed	1.80 to 2.05	2.20 to 2.50	9 to 10	2 to 3	....	1.50 to 2
Found.	2.34	2 84	9.27	1.64	10.91	1.96
Guaranteed	1.65 to 2.50	2 to 3	....	....	9 to 12	....
Found.	3.64	4.41	10.19	2.42	12.61	....
Guaranteed	....	....	13 to 16	....	....	....
Found.	....	....	12.57	....	....	....
Guaranteed	8.20 to 10.70	10 to 13	....	....	....	....
Found.	8.74	10.61	....	....	....	....
Guaranteed	....	....	....	....	....	11.88 to 13.50
Found.	....	....	....	....	....	14.76

XXV. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Listers' Ag'l Chemical Works, Newark, N. J.	Lawn fertilizer.	Elmira.	204
Listers' Ag'l Chemical Works, Newark, N. J.	Perfect fertilizer.	Geneseo.	349
Listers' Ag'l Chemical Works, Newark, N. J.	Standard superphosphate of lime.	E. Bloomfield. Penn Yan. Geneseo.	254 280 348
Listers' Ag'l Chemical Works, Newark, N. J.	Success.	Penn Yan. Dundee. East Avon. Caledonia.	281 285 315 324
Frederick Ludlam, New York city.	Cereal brand.	Wyoming.	597
Frederick Ludlam, New York city.	Sickle brand.	Wyoming.	598
Mapes Formula and Peruvian Guano Co., New York city.	Cabbage and cauliflower manure.	Port Jervis.	426
Mapes Formula and Peruvian Guano Co., New York city.	Complete manure—brand A.	Port Jervis.	424
Mapes Formula and Peruvian Guano Co., New York city.	Corn manure.	Port Jervis.	425
Mapes Formula and Peruvian Guano Co., New York city.	Fruit and vine manure.	Newburgh.	434
Mapes Formula and Peruvian Guano Co., New York city.	Potato manure.	Port Jervis.	423
Maryland Fertilizer and Manufacturing Co., Baltimore, Md.	Alkaline bone.	Lima. Mount Morris.	335 305
Maryland Fertilizer and Manufacturing Co., Baltimore, Md.	Linden superphosphate.	Mount Morris.	336
C. Meyer, Jr., Maspeth, L. I.	Acme potato fertilizer.	Aquebogue, L. I.	501
C. Meyer, Jr., Maspeth, L. I.	Superior superphosphate.	Stanley.	18

FERTILIZERS, ETC.—(*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed	1.65 to 2.50	2 to 3	7 to 8	....	....	3.50 to 4
Found.	2.13	2 58	8.26	0.11	8.37	4.50
Guaranteed	1 to 1.65	1.20 to 2	10.50 to 12	....	....	1.50 to 2 50
Found.	2.19	2.66	10.82	0.60	11.42	2.59
Guaranteed	2.35 to 2.70	2.85 to 3.25	10 to 12	2 to 3	12 to 15	1.50 to 2
Found.	2.77	3.36	9 52	0.45	9.97	2.53
Guaranteed	1.00 to 1.65	1.25 to 2.00	10.50 to 12	....	....	1.60 to 2
Found.	1.73	2.09	9.53	0.55	10.08	2.47
Guaranteed	1.23 to 1.65	1.05 to 2	10 to 12	1 to 3	10 to 14	2.15 to 3.25
Found.	1.38	1.67	9.57	1.60	11.06	2.63
Guaranteed	....	....	11 to 15	1 to 3	12 to 18	3 to 4
Found.	....	....	10.94	3.08	14.02	2.65
Guaranteed	4.50 to 5.35	5.50 to 6.50	6	....	6 to 8	8 to 10
Found.	4.61	5.59	8.55	1.18	9.73	12.20
Guaranteed	2.50 to 3.30	3 to 4	10 to 12	2 to 4	....	2.50 to 3 50
Found	2.68	3.24	12.79	1.95	14.74	3.06
Guaranteed	3.70 to 4.50	4.50 to 5.50	8 to 10	2	10 to 12	6 to 7
Found.	3.95	4.79	10.67	1.37	12.04	8.13
Guaranteed	1.65 to 2.50	2 to 3	7 to 9	....	....	11 to 12
Found.	2.51	3.04	9.42	0.30	9.72	14.70
Guaranteed	3.70 to 4.10	4.50 to 5	8 to 10	....	....	6 to 8
Found.	4.01	4.86	9.14	1.42	10.56	9.06
Guaranteed	....	....	10 to 15	....	....	3 to 4
Found.	....	....	10.96	0.50	11.46	3.11
Guaranteed	....	....	10 to 13	1 to 2	11 to 14	2 to 4
Found.	....	....	10.12	0.54	10.66	3.09
Guaranteed	2.90 to 3 30	3.50 to 4	6 to 7	....	7 to 8	8 to 10
Found	3.14	3.81	7.93	1.21	9.14	8.28
Guaranteed	1.25 to 1.65	1.5 to 2	....	....	8 to 9	4 to 5
Found	1.92	2.33	11.27	....	11.98	5.62

XXV. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Michigan Carbon Works, Detroit, Mich.	Homestead super-phosphate.	Penn Yan.	282
Michigan Carbon Works, Detroit, Mich.	Homestead tobacco grower.	Livonia Station.	307
Michigan Carbon Works, Detroit, Mich.	Jarves drill phosphate.	Castile.	611
H. S. Miller & Co., Newark, N. J.	Ammoniated dissolved bone.	Hopewell.	176
H. S. Miller & Co., Newark, N. J.	Ammoniated dissolved bone.	Arcade.	631
H. S. Miller & Co., Newark, N. J.	Bone and potash.	Penn Yan. Geneseo.	270 345
H S. Miller & Co., Newark, N. J.	Ground bone.	Elmira. Arcade.	201 630
H. S. Miller & Co., Newark, N. J.	Harvest Queen.	Halls Corners. Penn Yan. Geneseo.	197 268 346
H. S. Miller & Co., Newark, N. J.	Standard superphosphate of lime.	Halls Corners. Penn Yan.	196 269
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Buffalo guano.	Rushville.	183
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Dissolved bone and potash.	Castile.	613
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Erie king.	Angelica. Alfred Center.	591 575
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Erie king.	Geneseo.	343
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Pure dissolved bone.	Angelica.	589
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Wheat phosphate.	Phelps.	154

FERTILIZERS, ETC. — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed Found.	1.85 to 2 60 1.94	2.25 to 3.15 2.36	8 to 11 8.54	.... 0.37	.... 8.91	1.50 to 2 1.77
Guaranteed Found.	3 to 4 3.08	3.60 to 4.80 3.70	10 to 11 12.05	.... 0.85	.... 12.90	3.50 to 4.00 3.24
Guaranteed Found.	1.00 to 1.65 1.32	1.25 to 2 1.60	8 to 9 9.93	2 to 3 1.40	10 to 12 11.34	0.27 to 0.54 1.54
Guaranteed Found.	1.85 to 2.05 1.78	2.25 to 2.5 2.16	9 to 10 8.88	1.5 to 2.5 1.38	10 to 12 10.26	2.5 to 3 3.42
Guaranteed Found.	1.60 to 2 2.17	2 to 2.50 2.64	8 to 10 9.31	0.50 to 2.50 0.86	.... 10.17	1.50 to 2 2 83
Guaranteed Found.	....	....	10 to 12 10.32	.... 0.44	.... 10.76	2.50 2.31
Guaranteed Found.	2.50 2.82	3 to 3.10 3.41	....	....	20 to 25 21.45	....
Guaranteed Found.	1.00 to 1 65 1.54	1.25 to 2 1.87	10 to 12 9.97	.... 0.90	.... 10.87	1.50 to 2 3.44
Guaranteed Found.	2.35 to 2.70 2.52	2.85 to 3.25 3.05	10 to 12 10.17	1.50 to 2.50 1.02	11.50 to 14.50 11.19	1.50 to 2 3.13
Guaranteed Found.	1.65 to 2.50 1.84	2 to 3 2.23	7 to 11 8.22	3 to 4 1.76	10 to 15 9.98	1 to 2 1.37
Guaranteed Found.	....	....	8 to 11 9.02	3 to 5 1.79	11 to 16 10.81	1.65 to 1.75 2.20
Guaranteed Found.	0.83 to 1.65 1.22	1 to 2 1.48	8.45 to 10.45 9.07	4 to 5 1.26	12.45 to 15.45 10.33	1.90 to 2.10 2.74
Guaranteed Found.	0.83 to 1.65 1.84	1 to 2 2.24	8.45 to 10.45 9.80	4 to 5 2.90	12.45 to 15.45 12.70	1.90 to 2.10 1.40
Guaranteed Found.	....	....	11 to 13 10.88	1.37 to 2.37 1.33	12.37 to 15.37 12.21	....
Guaranteed Found.	1.65 to 3 30 1.74	2 to 4 2.11	8 to 10 7.79	2 to 3 2.43	10 to 13 10.21	2 to 3 3.67

XXV. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Northwestern Fertilizer Co., Chicago, Ill.	Horseshoe brand pure ground bone.	Collins.	662
Northwestern Fertilizer Co., Chicago, Ill.	Challenge corn grower.	Collins.	663
Pacific Guano Co., Boston, Mass.	Soluble Pacific guano.	Stanley. Durhamville. Seneca Castle.	172 185 288
Quinnipiac Co., New London, Conn.	Ammoniated dissolved bone.	Milo. Milo Center. N. Bloomfield. Livonia Station	283 251 264 309
Quinnipiac Co., New London, Conn.	Climax phosphate.	N. Bloomfield.	265
Read Fertilizer Co., New York city.	Empire State.	Sennett. Syracuse. Orleans. Stanley.	51 25 174 182
Read Fertilizer Co., New York city.	Farmer's friend.	Syracuse. Lima.	42 306
Read Fertilizer Co., New York city.	Lion brand.	Syracuse. Sennett. E. Bloomfield.	31 52 256
John S. Reese & Co., Baltimore, Md.	Tobacco & cabbage manure.	Mattituck, L. I.	505
Rochester Fertilizer Co., Rochester, N. Y.	Rochester bone and blood guano.	Penn Yan. Livonia Center. Moscow.	279 312 337
Sheldon Bros., Weedsport, N. Y.	Sheldon's compound.	Weedsport.	55-72
Standard Fertilizer Co., Boston, Mass.	Standard guano.	Avon.	316
H. Steppenback, Utica, N. Y.	Home trade.	Utica.	296
W. D. Stewart & Co., New York city.	A No. 1.	Durhamville.	290

FERTILIZERS, ETC. — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed	2.05 to 2.90	2.50 to 3.50	....	....	22 to 24	....
Found.	2.92	3.54	13.83	4.84	18.67	....
Guaranteed	1.65 to 2.50	2 to 3	8 to 9	2 to 3	10 to 12	0.54 to 1.08
Found.	2.38	2.88	10.46	4.29	14.75	1.53
Guaranteed	2.05 to 2.85	2.50 to 3.50	8 to 10	2 to 4	11 to 14	1.50 to 2.50
Found.	2.36	2.87	10.16	1.30	11.46	2.68
Guaranteed	1.65 to 2.50	2 to 3	9 to 12	....	11 to 14	2.15 to 3.25
Found.	1.96	2.38	10.08	1.43	11.51	2.76
Guaranteed	0.83 to 1.65	1 to 2	9 to 10	1 to 2	11 to 12	2.16 to 2.70
Found.	1.37	1.67	10.43	0.95	11.38	2.95
Guaranteed	1.25 to 2	1.50 to 2.50	9 to 11	2 to 3	11 to 13	2.15 to 3.25
Found.	1.56	1.90	9.11	2.48	11.59	2.35
Guaranteed	2 to 2.90	2.50 to 3.50	9 to 11	2 to 4	11 to 14	2.15 to 3.25
Found.	1.97	2.40	9.10	2.08	11.08	2.24
Guaranteed	0.83 to 1.65	1 to 2	8 to 10	2 to 3	10 to 12	4.30 to 5.40
Found.	1.33	1.60	8.34	1.54	9.88	4.79
Guaranteed	4.10 to 4.95	5 to 6	....	....	6 to 10	5 to 6
Found.	4.08	4.95	7.46	2.61	10.07	5.50
Guaranteed	0.20 to 0.40	0.25 to 0.50	8 to 10	1 to 2	9 to 10	1.50 to 2.50
Found.	0.83	1.00	8.09	0.47	8.56	2.15
Guaranteed	0.60 to 1.20	0.75 to 1.50	5 to 7	2 to 3	7 to 9	2 to 3
Found.	0.72	0.88	5.18	0.31	5.49	3.31
Guaranteed	1 to 2	1.5 to 3	8 to 12	2 to 3	10 to 15	2.16 to 3.20
Found.	1.12	1.36	7.86	3.82	11.68	2.19
Guaranteed	2.50 to 3.30	3 to 4	8 to 12	1 to 2	....	2 to 3
Found.	3.27	3.96	8.55	0.18	8.73	2.55
Guaranteed	1.25 to 2	1.50 to 2.40	7 to 9	2 to 3	9 to 11	1.50 to 2.50
Found.	1.32	1.60	8.25	1.81	10.06	1.56

XXV. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
W. D. Stewart & Co., Boston, Mass.	Nobsque guano.	Stanley.	186
W. D. Stewart & Co., Boston, Mass.	Pacific soluble bone.	Nunda.	596
F. C. Sturdevant, Hartford, Conn.	Granulated tobacco and sulphur.	Middletown.	428
Geo. F. Tuthill, Greenpoint, L. I.	Fish scrap.	Greenport.	509
Walker Fertilizer Co., Phelps Junction, N. Y.	Ammoniated phosphate.	Rushville.	187
Williams & Clark Fertilizer Co., New York city.	Prolific crop producer.	Cuba.	638
Williams & Clark Fertilizer Co., New York city.	Royal bone phosphate.	York.	329
Williams & Clark Fertilizer Co., New York city.	Royal bone phosphate.	Cuba.	636
Zell Guano Co., Baltimore, Md.	Calvert guano.	Wayland. Alfred Center. Cuba.	551 581 635
Zell Guano Co., Baltimore, Md.	Dissolved bone phosphate.	Alfred Center.	579
Zell Guano Co., Baltimore, Md.	Zell's economizer.	Cheshire. Stanley.	165 190

Fertilizers, Etc. — (*Concluded*).

	Nitrogen.		Phosphoric Acid.			Potash, soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed Found.	1.15 to 1.65 1.10	1.4 to 2 1.32	9 to 12 9.36	.... 0.44	.... 10.80	2 to 3 2.86
Guaranteed Found.	....	....	12 to 15 13.91	....	....	....
Guaranteed Found.	1.95 2.27	2.35 2.74	....	....	0.75 0.95	7.66 9.42
Guaranteed Found.	8.23 9.48	10.00 11.50	.... 6.17	.... 0.49	6.00 6.66	....
Guaranteed Found.	1.65 to 2.50 1.78	2 to 3 2.17	7 to 9 7.73	.... 2.94	.... 10.67	1 to 2 1.91
Guaranteed Found.	0.83 to 1.65 1.97	1 to 2 2.37	5 to 6 6.62	1 to 2 1.72	6 to 8 8.34	1 to 2 2.42
Guaranteed Found.	0.83 to 1.65 1.52	1 to 2 1.84	7 to 9 8.32	1 to 2 1.80	8 to 10 10.12	2 to 3 2.90
Guaranteed Found.	0.83 to 1.65 1.70	1 to 2 2.05	7 to 9 8	1 to 2 2.11	8 to 11 10.11	2 to 3 3.06
Guaranteed Found.	0.63 to 1.25 0.85	0.75 to 1.50 1.03	9 to 11 10.47	3 to 5 1.84	11 to 15 12.31	1.50 to 2.50 2.32
Guaranteed Found.	....	....	13 to 16 13.54	2 to 3 0.47	15 to 18 14.01	....
Guaranteed Found.	0.83 to 1.65 1.05	1 to 2 1.23	9 to 11 10.86	2 to 3 1.28	11 to 14 12.14	1 to 2 2.10

XXVI. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS

Composition of fertilizers as guaranteed by manufacturers, and

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
H. J. Baker & Bro., 215 Pearl street, New York city.	AA ammoniated super-phosphate.	Queens, L. I.	119
H. J. Baker & Bro., 215 Pearl street, New York city.	Complete potato manure.	Flatbush, L. I. Queens, L. I. Canarsie, L. I.	77 91 120
Bowker Fertilizer Co., Boston and New York.	Alkaline bone.	York.	446
Bowker Fertilizer Co., Boston and New York.	Ammoniated bone phosphate.	Rochester.	236
Bowker Fertilizer Co., Boston and New York.	Carpenter's special fertilizer for cabbage.	Jamaica, L. I.	107
Bowker Fertilizer Co., Boston and New York.	Carpenter's special fertilizer for potatoes.	Jamaica, L. I.	106
Bowker Fertilizer Co., Boston and New York.	G. & T. high-grade potato manure.	Riverhead, L. I.	514
Bowker Fertilizer Co., Boston and New York.	Hill and drill phosphate.	Rochester. Ilion.	235 145
Bowker Fertilizer Co., Boston and New York.	Stockbridge potato manure.	Southold, L. I.	518
Bowker Fertilizer Co., Boston and New York.	Stockbridge special complete manure for potatoes & vegetables.	Ilion. Rochester.	141 237
Bowker Fertilizer Co., Boston and New York.	Stockbridge special complete manure for strawberries.	Ilion.	142
Bowker Fertilizer Co., Boston and New York.	Stockbridge special complete manure for corn.	Ilion.	143

IN NEW YORK STATE FOR THE SPRING OF 1891.

as found by chemical analysis — estimated in parts per hundred.

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed Found.	2.5 to 3.3 3.49	3 to 4 4.24	10 to 12 13.21	1 to 3 0.43	11 to 15 13.64	2 to 3 2.92
Guaranteed Found.	3.3 4.22	4 5.13	5.75 8.06	.... 0.32	.... 8.38	10 11.33
Guaranteed Found.	....	....	11 to 13 10.56	1 to 2 2.16	12 to 15 12.72	1 to 2 1.15
Guaranteed Found.	1.65 to 2.5 2.36	2 to 3 2.86	8 to 10 8.59	.... 2.19	10 to 12 10.78	2 to 3 2.93
Guaranteed Found.	4.5 to 5.35 4.47	5.5 to 6.5 5.42	5 to 7 7.35	.... 1.69	.... 9.04	6.5 to 7.5 7.27
Guaranteed Found.	3.3 to 4.5 3.20	4 to 5.5 3.89	7 to 9 7.54	.... 1.85	.... 9.39	6.5 to 7.5 9.42
Guaranteed Found.	3.3 to 4.1 4.26	4 to 5 5.16	7 to 9 6.75	.... 2.36	.... 9.11	7 to 9 7.06
Guaranteed Found.	2.05 to 2 90 2.00	2.5 to 3.5 2.43	8 to 10 8.51	.... 3.37	.... 11.88	2 to 3 2.61
Guaranteed Found.	3 3 to 4.1 3.72	4 to 5 4.52	7 to 9 7.45	.... 3.12	.... 10.57	7 to 9 6.79
Guaranteed Found.	3.3 to 4.1 3.85	4 to 5 4.67	7 to 8 7.75	1 to 2 2.35	8 to 10 10.10	5 to 6 6 36
Guaranteed Found.	2.5 to 3.3 3.39	3 to 4 4.10	6 to 7 9.93	1 to 2 3.03	7 to 9 12.96	4.3 to 5.4 4.32
Guaranteed Found.	3.3 to 4.1 3.40	4 to 5 4.11	8 to 9 10.33	1 to 2 2.96	9 to 10 13.29	4.4 to 5.65 4.24

XXVI. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bowker Fertilizer Co., Boston and New York.	Sure crop bone phosphate.	Rochester. Spencerport.	234 379
Bradley Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Brockport.	372
Bradley Fertilizer Co., Boston, Mass.	Complete manure for corn and grain.	Geneva.	388
Bradley Fertilizer Co., Boston, Mass.	Complete manure for potatoes and vegetables.	Gravesend, L. I. Jamaica, L. I. Flatlands, L. I.	90 133 78
Bradley Fertilizer Co., Boston, Mass.	Farmer's new method.	Rome. Rochester. Brockport. Spencerport.	207 229 368 380
Bradley Fertilizer Co., Boston, Mass.	Patent superphospate.	Rome. Waterloo. Rochester. Brockport.	206 210 231 371
Bradley Fertilizer Co., Boston, Mass.	Potato fertilizer.	Rome. Waterloo. Rochester. Brockport.	208 211 232 373
Bradley Fertilizer Co., Boston, Mass.	Sea fowl guano.	Rochester,	228
Bradley Fertilizer Co., Boston, Mass.	Vegetable fertilizer.	Rochester.	230
E. B. Chapin, Rochester, N. Y.	Standard phosphate.	Rochester.	298
Chemical Company of Canton, Baltimore, Md.	Special potato fertilizer.	Mattituck, L. I.	530
E. Frank Coe, 16 Burling Slip, New York city.	Blue brand excelsior guano.	Jamaica, L. I.	126
E. Frank Coe, 16 Burling Slip, New York city.	Excelsior guano	Jaimaca, L. I.	127
E. Frank Coe, 16 Burling Slip, New York city.	Gold brand excelsior guano.	Jaimaca, L. I.	124

FERTILIZERS, ETC.—(*Continued.*)

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed Found.	0.83 to 1.65 1.17	1 to 2 1.42	8 to 10 8.01	2 1.72	10 to 12 9.73	1 to 2 2.90
Guaranteed Found.	1.65 to 2.5 2.53	2 to 3 3.07	7 to 9 10.90	1 to 2 1.88	8 to 10 12.78	1 to 2 1.97
Guaranteed Found.	2.9 to 3.7 3.76	3.5 to 4.5 4.56	8 to 10 11.00	1 to 2 1.72	9 to 12 12.72	3 to 4 6.21
Guaranteed Found.	3.3 to 4.1 3.94	4 to 5 4.78	8.5 to 10 9.20	.... 0.84	10 to 12 10.04	7 to 8 8.32
Guaranteed Found.	0.83 to 1.65 1.39	1 to 2 1.68	8 to 10 8.39	2 1.78	10 to 12 10.17	4 to 6 3.66
Guaranteed Found.	2.05 to 2.90 2.16	2.5 to 3.5 2.62	8 to 10 9.88	2 2.15	10 to 12 12.03	1.5 to 2.5 4.10
Guaranteed Found.	2.05 to 2.90 2.20	2.5 to 3.5 2.66	9 to 10 8.90	.... 2.10	11 to 12 11.00	6 to 8 6.34
Guaranteed Found.	2.05 to 2.90 2.69	2.5 to 3.5 3.27	8 to 10 9.23	.... 1.68	10 to 12 10.91	1.5 to 2.5 2.79
Guaranteed Found.	2.9 to 3.9 3.50	3.5 to 4.7 4.24	9 to 11 10.22	.... 1.75	11 to 13 11.97	2 to 3 3.13
Guaranteed Found.	1.65 to 2.05 2.15	2 to 2.5 2.61	8 to 10 8.13	.... 1.87	.... 10.00	1.6 to 2.15 2.78
Guaranteed Found.	2.5 to 3.3 3.25	3 to 4 3.94	6 to 7 7.16	.... 0.84	.... 8.00	8 to 10 8.81
Guaranteed Found.	6 6 to 8.2 6.76	8 to 10 8.21	6 to 8 8.22	2 to 3 0.75	.... 8.97	2.5 to 3 3.28
Guaranteed Found.	3.3 to 4.1 3.70	4 to 5 4.50	9 to 12 9.97	1 to 2 1.28	10 to 12 11.25	3.40 5.18
Guaranteed Found.	2.5 to 3.3 2.80	3 to 4 3.39	8 to 10 8.19	1 to 2 0.67	8 to 10 9.86	6 to 8 6.61

XXVI. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
E. Frank Coe, 16 Burling Slip, New York city.	Red brand excelsior guano.	Jamaica, L. I.	125
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated bone superphosphate.	Rome. Brockport.	149 365
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated wheat and corn phosphate.	Geneva.	390
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Dissolved bone black.	Brockport.	366
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	New rival ammoniated superphosphate.	Rome. Brockport.	148 363
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Special potato manure.	Brockport.	364
Darling Fertilizer Co., Pawtucket, R. I.	Animal fertilizer	New Suffolk, L.I.	527
J. H. Devins, Utica, N. Y.	J. H. Devins fertilizer.	Utica.	140
Ellsworth, Tuthill & Co., Promised Land, L. I.	No. 2 fertilizer.	Promised Land, L. I.	529
Farmers' Fertilizer Co., Syracuse, N. Y.	Fair and square.	Geneva.	391
G. B. Forrester, New York city.	Potato manure.	Flatlands, L. I. Canarsie, L. I. Gravesend, L. I. Jamaica.	68 84 88 132
Great Eastern Fertilizer Co., New York city.	Garden special.	Hollis, L. I.	118
Great Eastern Fertilizer Co., New York city.	Garden special.	Mattituck, L. I.	532
Great Eastern Fertilizer Co., New York city.	Vine and tobacco fertilizer.	Mattituck, L. I.	533
Hallock & Duryea, Mattituck, L. I.	No. 1 fertilizer.	Aquebogue, L. I.	528

FERTILIZERS, ETC.—(*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash, soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed	3.3 to 4.1	4 to 5	9 to 12	1 to 3	8 to 12	6
Found.	3.50	4.24	9.54	0.79	10.34	5.67
Guaranteed	2.9 to 3.7	3.5 to 4.5	10 to 12	1 to 2	11 to 13	1.1 to 1.6
Found.	3.18	3.85	9.50	1.62	11.12	2.26
Guaranteed	2.05 to 2.9	2.5 to 3.5	10 to 13	1 to 2	11 to 15	1.75 to 2.8
Found.	4.00	4.85	10.65	0.45	11.10	3.75
Guaranteed	....	....	15 to 18	....	....	....
Found.	....	....	17.05	0.45	17.50	....
Guaranteed	1.25 to 2.05	1.5 to 2.5	10 to 12	1 to 3	11 to 15	1.6 to 2.2
Found.	1.76	2.13	10.59	2.86	13.45	3.11
Guaranteed	3.7 to 4.5	4.5 to 5.5	8 to 9	1 to 2	9 to 10	5.5 to 6.5
Found.	4.55	5.52	7.78	1.59	9.37	6.09
Guaranteed	3.3 to 4.95	4 to 6	7 to 9	....	....	9 to 11
Found.	4.71	5.72	6.80	2.30	9.10	8.57
Guaranteed	2.5 to 3.3	3 to 4	7 to 9	2 to 3	9 to 12	2 to 3
Found.	3.24	3.93	7.70	2.91	10.61	2.47
Guaranteed	4.1	5	4	....	....	7
Found.	4.59	5.57	4.03	0.25	4.28	7.79
Guaranteed	2.5 to 4.1	3 to 5	7 to 9	1 to 2	8 to 11	0.54 to 1.08
Found.	2.95	3.57	10.84	0.99	11.83	1.78
Guaranteed	3.70	4.5	5.5	....	....	10
Found.	4.64	5.63	6.47	0.28	6.75	11.21
Guaranteed	3.3 to 4.1	4 to 5	6 to 8	....	....	8 to 10
Found.	3.00	3.63	7.77	0.86	8.63	8.77
Guaranteed	3.3 to 4.1	4 to 5	6 to 8	....	....	8 to 10
Found.	3.82	4.65	6.94	0.87	7.81	7.65
Guaranteed	2.05 to 2.5	2.5 to 3	8 to 12	1 to 3	9 to 15	6 to 8
Found.	2.72	3.30	8.37	0.47	8.84	8.22
Guaranteed	3.3 to 4.95	4 to 6	7 to 9	....	....	9 to 11
Found.	3.79	4.60	7.64	0.10	7.74	9.14

XXVI. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Lister's Agricultural and Chemical Works. Newark, N. J.	Ammoniated dissolved bone.	Rochester. Brockport. Rome.	226 375 147
Lister's Agricultural and Chemical Works, Newark, N. J.	Dissolved bone black.	York.	445
Lister's Agricultural and Chemical Works, Newark, N. Y.	Perfect fertilizer.	Rochester.	227
Lister's Agricultural and Chemical Works, Newark, N. J.	Potato manure.	Flatlands, L. I.	79
Lister's Agricultural and Chemical Works, Newark, N. J.	Potato No. 2.	Rochester.	225
Listers' Agricultural and Chemical Works, Newark, N. J.	Standard superphosphate of lime.	Brockport. Rome.	377 146
Listers' Agricultural and Chemical Works. Newark, N. J.	Success.	Rochester. Spencerport.	224 378
Listers' Agricultural and Chemical Works, Newark, N. J.	Cauliflower and cabbage fertilizer.	Flatlands, L. I.	80
Frederick Ludlam, 140 Maiden lane, New York city.	Cecrops or dragon's tooth brand.	Flatlands, L. I.	82
Mapes' Formula and Peruvian Guano Co., New York city.	Cabbage and cauliflower manure.	Flatlands, L. I.	75
Mapes' Formula and Peruvian Guano Co., New York city.	Complete manure, A brand.	Flatlands, L. I.	74
Mapes' Formula and Peruvian Guano Co., New York city.	Complete manure for light soils.	Jamaica, L. I.	103
Mapes' Formula and Peruvian Guano Co, New York city.	Economical manure.	Southold, L. I.	522
Mapes' Formula and Peruvian Guano Co., New York city.	Nitrogenized superphosphate.	Southold, L. I.	523
Mapes' Formula and Peruvian Guano Co., New York city.	Potato manure L. I. special.	Jamaica, L. I.	102

FERTILIZERS, ETC.— (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash, soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed	1.8 to 2.05	2.2 to 2.5	9 to 10	....	....	1.5 to 2
Found.	2.33	2.82	11.36	1.20	12.56	2.98
Guaranteed	....	....	10 to 13	....	....	....
Found.	....	....	11.95	1.48	13.43	....
Guaranteed	1.00 to 1.65	1.25 to 2	10.5 to 12	....	....	1.5 to 2
Found.	1.56	1.89	11.55	1.68	13.23	2.52
Guaranteed	3.7 to 4.1	4.5 to 5	7.5 to 9	....	....	7 to 8
Found.	4.10	5.01	8.31	0.35	8.66	8.10
Guaranteed	1.8 to 2.5	2.2 to 3	9.25 to 11	....	....	4 to 5
Found.	2.16	2.60	12.01	1.03	13.04	4.62
Guaranteed	2.35 to 2.7	2.85 to 3.25	10 to 12	2 to 3	....	1.5 to 2
Found.	2.36	2.87	10 86	1.95	12.81	2.32
Guaranteed	1 to 1.65	1.25 to 2	10.5 to 12	....	....	1.5 to 2
Found.	2.08	2.52	11.55	1.06	12.61	3.11
Guaranteed	3.7 to 4.1	4.5 to 5	7.5 to 9	....	....	7 to 8
Found.	3.54	4.30	7.90	0.37	8.27	8.40
Guaranteed	3.3 to 4.1	4 to 5	7 to 9	....	....	7 to 9
Found.	3.02	3.88	7.29	2.07	9.36	8.83
Guaranteed	4.1 to 5.35	5 to 6	6 to 8	....	....	6 to 8
Found.	3.80	4.61	7.80	1.24	9.04	6.31
Guaranteed	2.5 to 3.3	3 to 4	10 to 12	2 to 4	12 to 16	2.5 to 3.5
Found.	2.72	3.30	13.06	1.14	14.20	4.61
Guaranteed	4.95 to 6.6	6 to 8	7 to 9	....	....	6 to 8
Found.	4.41	5.35	7.85	0.97	8.82	7.44
Guaranteed	2.5 to 3.3	3 to 4	6 to 8	2	8 to 10	8 to 10
Found.	3.39	4.11	8.82	1.30	10.12	9.03
Guaranteed	2.05 to 2.5	2.5 to 3	9 to 11	2	11 to 13	2.5 to 3
Found.	2.99	3.62	12.48	1.01	13.49	2.98
Guaranteed	3.3 to 4.1	4 to 5	6 to 8	....	7 to 9	7 to 9
Found.	3.37	4.08	8.64	0.53	9.17	7.87

XXVI. Results of Analyses of Commercial

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Mapes' Formula and Peruvian Guano Co., New York city.	Vegetable manure, L. I. special.	Flatlands, L I.	76
Maryland Fertilizing Co., Baltimore, Md.	Linden superphosphate.	Waterloo.	219
Maryland Fertilizing Co., Baltimore, Md.	Potato food.	Waterloo.	218
Maryland Fertilizing Co., Baltimore, Md.	Pure gold.	Waterloo.	216
Maryland Fertilizing Co., Baltimore, Md.	Sangston's cereal and plant food.	Pittsford.	355
Maryland Fertilizing Co., Baltimore, Md.	Tornado fertilizer.	Waterloo.	217
C. Meyer, Jr., Maspeth, L. I.	Acme fertilizer No. 1 for potatoes.	Parkville, L. I.	49
C. Meyer, Jr., Maspeth, L. I.	Acme fertilizer No. 2 for cabbage.	Parkville, L. I.	50
C. Meyer. Jr., Maspeth, L. I.	Acme potato fertilizer.	Aquebogue, L. I	515
Michigan Carbon Works, Detroit, Mich.	Homestead.	Livonia.	443
Michigan Carbon Works, Detroit, Mich.	Homestead potato grower.	Livonia.	442
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Buffalo fertilizer.	Canandaigua.	785
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Cyclone pure bone meal.	Pittsford.	354
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Pure dissolved bone.	Brockport.	360
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Vegetable bone fertilizer.	Pittsford. Spencerport.	351 382

FERTILIZERS, ETC.—(*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash, soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed Found.	4.1 to 4.95 4.12	5 to 6 5.00	7 to 9 7.69	.... 1.12	.... 8.81	4 to 6 6.18
Guaranteed Found.	....	....	10 to 13 10.67	1 to [illegible] 0.80	.... 11.47	2 to 4 1.96
Guaranteed Found.	2.25 to 2.7 3.01	2.75 to 3.25 3.65	10 to 13 9.89	1 to 2 2.30	.... 12.19	2.5 to 3 3.26
Guaranteed Found.	....	....	10.5 to 14 12.27	1 to 2 0.25	.... 12.52	3.25 to 4 4.89
Guaranteed Found.	1 to 1.65 1.42	1.25 to 2 1.72	10 to 13 9.72	1 to 2 2.53	.... 12.25	2.25 to 3.5 3.56
Guaranteed Found.	0.42 to 0.83 1.22	0.5 to 1 1.47	10 to 15 11.08	1 to 2 0.55	11 to 15 11.63	3 to 4 4.43
Guaranteed Found.	3.3 to 4.1 4.18	4 to 5 5.08	7 to 8 8.35	.... 1.12	8 to 9 9.47	9 to 10 9.42
Guaranteed Found.	4.95 to 5.35 5.20	6 to 6.5 6.32	7 to 8 8.92	.... 1.28	8 to 9 10.20	5 to 6 7.14
Guaranteed Found.	2.9 to 3.3 3.45	3.5 to 4 4.19	7 to 8 8.22	.... 1.01	.... 8.23	8 to 10 7.78
Guaranteed Found.	1.85 to 2.4 3.39	2.25 to 3.15 4.08	8 to 11 8.75	.... 1.52	.... 10.27	1.5 to 1.75 1.79
Guaranteed Found.	3 to 4 4.02	3.5 to 4.75 5.10	10 to 11 11.30	.... 1.13	.... 12.43	3.5 to 4 3.93
Guaranteed Found.	2.5 to 3.8 2.66	3 to 4.65 3.23	8 to 12.30 12.35	2 to 3 1.14	10 to 15.30 13.49	1.5 to 2.5 3.07
Guaranteed Found.	3.3 to 4.1 4.82	4 to 5 5.85	....	....	25.00 23.46	....
Guaranteed Found.	....	....	11 to 13 13.59	1.37 to 2.37 1.67	12.37 to 15.37 15.26	....
Guaranteed Found.	4.1 to 4.95 4.07	5 to 6 4.94	8 to 10 8.16	3 to 4 1.56	11 to 14 9.72	5 to 6 7.56

XXVI. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Wheat, oats and barley phosphate.	Waterloo. Pittsford. Brockport.	214 300 358
L. Mittenmaier, Rome, N. Y.	Pride of America.	Rome.	209
National Fertilizer Co., Bridgeport, Conn.	Chittenden's complete fertilizer.	Queens, L. I.	123
J. E. Phelps, Jamaica, L. I.	Fish brand potato fertilizer.	Jamaica, L. I.	111
J. E. Phelps, Jamaica, L. I.	Highest grade perennial complete fertilizer.	Jamaica, L. I.	112
J. E. Phelps, Jamaica, L. I.	Perennial grain fertilizer.	Jamaica, L. I.	114
J. E. Phelps, Jamaica, L. I.	Perennial potato and cabbage fertilizer.	Jamaica, L. I.	113
Preston Fertilizer Co., Greenpoint, L. I.	Ammoniated bone superphosphate.	Queens, L. I.	122
Quinnipiac Co., New York city.	Ammoniated dissolved bone	Spencerport. Brighton.	386 243
Quinnipiac Co., New York city.	Climax phosphate.	Brighton.	242
Quinnipiac Co., New York city.	Fish, bone and potash.	Brighton.	240
Quinnipiac Co., New York city.	Market garden manure.	Hollis, L. I.	117
Quinnipiac Co., New York city.	Potato manure.	Jamesport, L. I.	525
Quinnipiac Co., New York city.	Potato phosphate.	Brighton.	244
Quinnipiac Co., New York city.	Soluble dissolved bone.	Brighton.	241

FERTILIZERS, ETC.— (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash, soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed Found.	1.65 to 3.3 2.00	2 to 4 2.42	8 to 10 7.83	2 to 3 2.24	10 to 13 10.07	2 to 3 3.51
Guaranteed Found.	1.65 to 2.5 2.97	2 to 3 3.60	6 to 9 6.26	.... 1.24	.... 7.50	3 to 6 2.56
Guaranteed Found.	3.3 to 4.1 3.94	4 to 5 4.78	6 to 8 9.06	.... 1.83	8 to 10 10.89	6 to 8 7.42
Guaranteed Found.	3.3 to 4.1 3.53	4 to 5 4.28	4 to 6 8.57	3 0.89	7.5 to 9 9.46	10 to 11 10.97
Guaranteed Found.	4.95 to 5.75 6.00	6 to 7 7.30	.... 11.48	.... 2.53	12.5 to 14 14.01	11 to 12 11.57
Guaranteed Found.	3.3 to 4.1 3.44	4 to 5 4.18	.... 11.92	.... 6.28	14.5 to 16 18.20	7 to 8 7.05
Guaranteed Found.	4.1 to 4.95 4.41	5 to 6 5 36	.... 9.15	.... 2.69	11.5 to 13 11.84	11 to 12 11.56
Guaranteed Found.	2.5 to 3.3 3.41	3 to 4 4.13	9 to 11 9.17	.... 1.09	.... 10.26	2 to 3 4.19
Guaranteed Found.	2 to 3 2.69	2.4 to 3.6 3.23	9 to 12 10.25	.... 1.04	10 to 14 11.29	2.15 to 3.25 3.75
Guaranteed Found.	1 to 2 2.06	1.2 to 2.4 2.51	9 to 10 9.53	.... 0.61	11 to 12 10.14	2.15 to 3.25 3.04
Guaranteed Found.	1.65 to 2.5 2.84	2 to 3 3.45	9 to 10 9.62	1 to 2 0.87	10 to 12 10.49	1 to 1.5 1.76
Guaranteed Found.	3.3 to 4.1 3.60	4 to 5 4.37	8 to 11 8.50	1 to 2 0.78	9 to 13 9.28	7 to 8 8.16
Guaranteed Found.	2.5 to 3.3 3.06	3 to 4 3.71	6 to 9 7.85	1 to 2 0.49	7 to 11 8.34	5.5 to 6.5 6.43
Guaranteed Found.	2.25 to 3.5 3.21	2.7 to 4.2 3.89	8 to 11 8.58	1 to 2 1.66	9 to 13 10.24	3 to 4 4.40
Guaranteed Found.	....	....	12 to 15 11.92	1 to 2 2.43	13 to 17 14.35	....

XXVI. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Read Fertilizer Co., New York city.	Farmer's friend.	Jamaica, L. I.	130
Read Fertilizer Co., New York city.	High grade farmer's friend.	Mattituck, L. I.	534
Read Fertilizer Co., New York city.	I. C. Hendrickson's complete fertilizer.	Jamaica, L. I.	110
Read Fertilizer Co., New York city.	Standard phosphate.	Spencerport.	385
John S. Reese & Co., Baltimore, Md.	Crown bone phosphate.	Brockport.	357
John S. Reese & Co., Baltimore, Md.	Great planet "A" manure.	Jamaica, L. I.	104
John S. Reese & Co., Baltimore, Md.	Great planet "B" manure.	Jamaica, L. I.	105
Rochester Fertilizer Co., Rochester, N. Y.	Alkali bone guano.	Lima.	436
Rochester Fertilizer Co., Rochester, N. Y.	Bone and blood guano.	Brockport.	374
Springfield Fertilizer Co., Springfield, Ohio.	Soluble bone phosphate.	Waterloo.	223
H. Stappenbeck, Utica, N. Y.	Home trade bone superphosphate.	Utica.	137
Sterling Oil Co., Promised Land, L. I.	Fish scrap.	Jamesport, L. I.	526
W. D. Stewart & Co., Boston, Mass.	Nobsque guano.	Brighton.	239
W. D. Stewart & Co., Boston, Mass.	Riverhead Town Agricultural Society fertilizer.	Aquebogue.	536
W. D. Stewart & Co., Boston, Mass.	Riverhead Town Agricultural Society fertilizer.	Aquebogue.	537

FERTILIZERS, ETC.— (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed Found.	1.85 to 2.5 2.30	2.25 to 3 2.79	9 to 11 9.52	2 to 3 1.18	11 to 13 10.70	1 to 2 3.88
Guaranteed Found.	3.3 to 4.1 3.21	4 to 5 3.89	7 to 9 7.81	.... 1.66	.... 9.47	7 to 9 7.89
Guaranteed Found.	3.3 to 4.1 3.08	4 to 5 3.73	7 to 9 8.16	.... 0.65	.... 8.81	7 to 9 7.63
Guaranteed Found.	0.83 to 1.65 1.12	1 to 2 1.36	8 to 10 8.52	2 to 4 1.03	10 to 14 9.55	4 to 6 4.33
Guaranteed Found.	....	....	12 to 14 13.37	.... 2.36	.... 15.73	3 to 4 3.16
Guaranteed Found.	3.3 to 4.1 3.28	4 to 5 3.98	7 to 9 7.57	.... 0.65	.... 8.22	9.5 to 11 10.87
Guaranteed Found.	4.95 to 5.75 5.06	6 to 7 6.14	5 to 6 7.23	.... 0.64	.... 7.87	7 to 9 7.73
Guaranteed Found.	....	....	8 to 10 8.80	.... 1.74	.... 10.54	3 to 5 2.82
Guaranteed Found.	1 to 1.85 1.29	1.15 to 2.25 1.57	8 to 10 8.82	.... 1.64	.... 10.46	1.6 to 2.7 1.61
Guaranteed Found.	0.83 to 1.65 2.25	1 to 2 2.73	6 to 8 8.44	1 to 2 1.69	7 to 10 10.13	3 to 4 4.98
Guaranteed Found.	2.5 to 3.3 3.06	3 to 4 3.71	8 to 12 9.23	1 to 2 0.96	.... 10.19	2 to 3 2.54
Guaranteed Found.	7.41 7.69	9 9.35	....	....	....	....
Guaranteed Found.	1.15 to 1.65 2.17	1.4 to 2 2.63	9 to 12 8.69	2 to 3 1.58	.... 10.27	2 to 3 2.47
Guaranteed Found.	4.10 4.21	5 5.11	8 8.43	.... 1.03	.... 9.46	10 10.30
Guaranteed Found.	4.10 3.82	5 4.64	8 8.57	.... 1.39	.... 9.96	10 9.88

XXVI. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
W. D. Stewart & Co., Boston, Mass.	T. and A.	Southold, L. I.	520
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Allen's potato manure.	Hollis, L. I. Flatlands, L. I.	116 81
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Cabbage manure	Hollis, L. I.	115
Williams & Clark, New York city.	Acorn brand acid phosphate.	Rochester. Waterloo.	249 221
Williams & Clark, New York city.	Americus brand ammoniated bone superphosphate.	Rochester.	246
Williams & Clark, New York city.	Dried blood and animal matter.	Rochester.	248
Williams & Clark, New York city.	Potato phosphate.	Jamaica, L. I.	108
Williams & Clark, New York city.	Royal bone phosphate.	Waterloo. Rochester.	220 247
Williams & Clark, New York city.	Universal ammoniated dissolved bone.	Jamaica, L. I.	109

FERTILIZERS, ETC.—(*Concluded*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed	2.5 to 3.3	3 to 4	8 to 10	....	....	6 to 8
Found.	2.74	3.32	8.10	0.87	8.97	6.53
Guaranteed	3.3 to 4.1	4 to 5	6 to 7	....	9 to 10	10 to 11
Found.	3.36	4.08	6.13	1.25	7.38	10.13
Guaranteed	3.7 to 4.5	4.5 to 5.5	7 to 8	....	9 to 10	5 to 6
Found.	4.58	5.56	10.65	0.62	11.27	5.28
Guaranteed	....	....	12 to 15	....	13 to 17	....
Found.	....	....	12.74	1.77	14.51	....
Guaranteed	2.5 to 3.3	3 to 4	10 to 12	....	11 to 14	2 to 3
Found.	3.38	4.10	10.99	1.13	12.12	2.80
Guaranteed	6.6 to 8.2	8 to 10	....	....	....	....
Found.	8.66	10.51	....	....	....	....
Guaranteed	2 to 3	2.4 to 3.6	7 to 9	....	8 to 10	6 to 8
Found.	2.51	3.04	8.59	1.42	10 01	6.54
Guaranteed	0.83 to 1.85	1 to 2.25	7 to 9	....	8 to 10	2 to 3
Found.	2.14	2.60	8.15	0.61	8.66	2.76
Guaranteed	2 to 3	2.4 to 3.6	8 to 11	1 to 2	9 to 12	2 to 3
Found.	2.28	2.77	9.65	1.25	10.90	3.56

REPORT OF ACTING HORTICULTURIST.

The work of this department for this year consisted of varietal tests of small fruits, continued work on the cross pollination of strawberries, tests of commercial fertilizers on small fruits, spraying with fungicides for fungoid diseases of small fruits, tests of the newly introduced varieties of potatoes, tests of commercial fertilizers on potatoes, spraying with fungicides for the potato blight, tests of vegetable novelties of late introduction, tests of commercial fertilizers on the yield of beans, tests of fertilizers on forced tomatoes, and minor matters of more or less value.

The policy of this department has been to test all the promising new fruits produced as soon as possible after they have been offered on the market, or before, if possible, and although it is claimed by some that the testing of varieties of fruits by the Experiment Station is of purely mechanical nature, and does not come strictly under the head of Station work, this Station takes the ground that it is the province of the Station to stand between the originator or introducer and the public, and as far as possible protect and aid the purchaser in his efforts to procure only the varieties of new fruits that equal or excel the well-known old varieties, and the prediction is ventured that the time is near when the public will demand a certificate of merit from the Experiment Stations before they will buy new varieties of fruits, however much they may be lauded by those interested in the sale of them. That it will be to the advantage of the originator and introducer no one can doubt, as the wide range of country covered by the Experiment Stations, their facilities for testing and comparing, and the honest, unprejudiced opinions formed by the persons in charge would give any fruit of merit a prestige more valuable than any amount of money spent in colored plates and puffing. One case to the point is a new strawberry, the originator of which quietly sent plants to the various Experiment Stations in the spring of 1890, saying he wished reports from these Stations, favorable or unfavorable, before placing it on the market. This past season it has fruited at these Stations, and reports were sent to him. He will now decide whether it has value enough over older varieties to warrant its introduction. If it has met with favorable commendations from the majority of the Stations, who will doubt but what those testimonials will more than pay for the one year of waiting while this variety was under test? Few horticultural workers, either amateur or professional, have the same advantages generally found in a well-equipped Experiment Station to compare new fruits with older varieties, or the means at their disposal to pursue a systematic line of comparison as new fruits are introduced.

The work of cross pollination of strawberries was continued last winter and spring with the same object in view as that of the season before. The seedlings resulting from the crosses made in 1889 and 1890 show the strong individuality of several of the varieties used as the mother plant, the majority of the seedling plants of certain crosses being of the same habit of growth and general appearance as the mother plant. These seedling plants should bloom next season, and give a partial solution of the questions of being able to breed either a perfect flowering or a pistillate variety at will, or to breed a variety for a certain purpose.

Since the season's work has been completed this Station has been in receipt of numerous inquiries in regard to the efficacy of any preparation for the prevention of the potato blight, and we are able to say that marked success has been obtained by the use of the Bordeaux mixture. At this Station a gain of forty-eight bushels per acre was made by the applications of this mixture, and but little less by the use of ammoniacal solution. From other Stations come testimonials to the same effect, notably from Rhode Island, where practically the same results have been obtained as at this Station. The discussion of this matter will be found in the body of this report.

The effects of spraying with fungicides for the anthracnose of the raspberry were not of a very satisfactory nature, and although it appeared that the plants sprayed with Bordeaux mixture were benefited to a certain extent, it is thought best to continue this work through a longer period before making any claims in regard to the matter. Sprayings were made for strawberry leaf blight with beneficial results, both in the use of Bordeaux mixture and ammoniacal solution, and it is probable that either of these remedies will be used to good advantage in the future. The use of fungicides in preventing gooseberry mildew will be discussed in the body of this report.

I would respectfully call attention to the fact that, at several of the fairs held in the western part of the State, this Station has made an exhibit consisting of the constituents of ten different cattle foods, showing the relative value of each; an exhibit showing the chemical composition of the ash of fruit and wood of five of the more common fruits, namely, apple, pear, cherry, plum and grape; twenty samples of materials used in making commercial fertilizers, and an exhibit of fruits affected by fungus and several of the most efficacious remedies used in preventing the growth of injurious fungi. These exhibits were shown in glass show bottles and were practical object lessons in their different lines. The Station also exhibited at the State fair, at Syracuse, forty-five varieties of apples, sixty varieties of grape, twenty varieties of pears, twelve of plums and fifty varieties of potatoes; also, an exhibit of fifty varieties of pasture, meadow and lawn grasses, and charts showing the fertilizing value and pounds of fertilizers per ton of twenty-one different crops, and the proximate analysis of eleven cattle foods.

This exhibit, as a whole, attracted a great deal of attention, and many words of commendation from the visitors at these various fairs. These several exhibits were accompanied by bulletins giving a description of each, and a large number of these bulletins were distributed to those interested in the lines of work exhibited. The value of attendance on fairs with these object lessons can not be overestimated, as it puts the work of the Station before a large number of those interested who find it impossible to visit the Station grounds.

SMALL FRUITS.

Under the head of small fruits we class first the strawberry, next the raspberry, third the blackberry, fourth the currant and fifth the gooseberry. The grape will be considered in a future bulletin. In a bulletin on strawberries issued from this Station in October, 1890, special stress was placed on the ease and cheapness of growing this fruit by farmers, allowing every family to be able to have strawberries for all purposes with but little expense of money or time. We shall endeavor, in this report, to urge more forcibly this matter of small fruit growing by the average farmer, showing as we hope the large profit both in health and money to be derived from a small fruit plantation of the several varieties of fruits that mature early, and give paying results in from one to three years. One objection usually raised by farmers when asked to grow small fruits is the lack of time and skill. These objections may be answered by saying that the time necessary to plant one-fourth of an acre of strawberries need not be more than to plant the same area of cabbage or potatoes, and, as to skill, anyone who has set cabbage, celery or sweet potatoes, can set strawberry plants. The knowledge of the fact that one must set perfect flowering varieties with the pistillate or imperfect varieties is essential, but, further than that, clean tillage is the only very important point to be impressed on one's mind. The item of cost of plants is also reckoned as one of the hindrances to the cultivation of this fruit, and, viewed in certain ways, it is a very large item, but, if plants of any of the older well-tested varieties are selected, they can be bought by the thousand cheaper than any of the newer varieties can be bought by the hundred. One should be able to get any of the standard varieties at from three to four dollars per thousand, which, if set in rows three feet apart and the plants two feet apart in the rows will take 7,260 plants per acre, making one-fourth of an acre cost from five to eight dollars for plants. The further cost depends on the amount of tillage given and the expense of help, while the returns will usually average 500 quarts on one-fourth acre, which, if calculated at ten cents a quart, will more than pay for plants and labor, leaving only the labor as the cost of the second year's crop, which often gives the best yield and at the same time gives runners to set in new plantation.

Of raspberries it will not be necessary to buy or set a large number of plants. Fifty plants of both red and black raspberries, if well taken care of, will yield all a family of six can use, both on their table during fruiting season and for canning. These, if manured well and kept from growing in a jungle of canes, will last six years, and give good returns. It will be well for one about to set out raspberries to select a few bushes of the yellow varieties, as they are of the right color to go with white currants, either for canning or for jelly. Of blackberries one must test several varieties or inform himself from some source in regard to their hardiness, as, in exposed localities, they are often found to winter-kill. There is no fruit that can be put to more uses than the blackberry, and, if the locality is in their favor, none that will yield a larger profit on the investment.

The currant is a fruit grown by almost everyone, and in many cases the only small fruit available to the housewife. This seems to be so, simply from the fact that the currant will stand almost any amount of abuse and live to bear fruit, but such fruit is small in berry, short of stem and the stem but partially filled. These bushes are often hidden by a growth of tall weeds that would kill anything but a currant.

Gooseberry bushes may often be found growing in a partially neglected condition in gardens, bearing crops of small mildewed fruits, but rarely does one see the English varieties with their large shiny leaves and luscious fruits as large as Damson plums. Those who have eaten at their prime these last will never again be satisfied with the small native varieties like Houghton or Mountain Seedling.

The growing of black currants seems to be on the increase at this time, and among the varieties tested here the Prince of Wales seems at this time to be the most productive, although the Champion Black, Lee's Prolific and Baldwin's Black are all first class.

STRAWBERRIES.

A DESCRIPTION OF THE NEWER VARIETIES.

Bessie, Imp. — A variety from Maryland. The growth of foliage is all that could be desired; leaves large and rich dark green fruit-stem weak, and fruits should lay on mulch. The few plants that fruited produced fruit of large size, but very soft; many plants were, however, barren. Even those in stool row, that were of very great size, failed to produce blossom, or fruit. Season early.

Beeder Woods, P. — This has proved the most productive newly tested variety fruited this year. Growth of plants, stocky; foliage, dark green; fruit-stems, long and weak; must be mulched; the fruits, which are produced in large clusters, are not extra large, but of good market size and hold their size through a long picking season. We picked fruits for twenty-one days. The berries are conical, showy, scarlet; too soft to ship long distances, and subacid.

California, P. — This is received from Delaware. It is of low stocky growth; very short fruit-stems; fruits long, conical, with distinct neck; color dark scarlet; average in size, and firm; quality good.

Duboise, P. — A variety originated at Newburgh, N. Y. Growth similar to Sharpless; the fruits of this variety are different from any variety of strawberry tested, being very dry and spongy, and not of good quality; neither do the plants produce a large yield.

Edgar Queen, P. — This variety is from Illinois; is a wonderfully vigorous growing variety. Each plant was covered with bloom, but did not resist the drought as well as other varieties. It looked as if it would prove a complete failure, but revived after a heavy shower and produced a fair crop. We think it would have been very fine if the season had been normal.

Greenville.— This Ohio seedling has the same habit of growth and general appearance as Sharpless, but is more productive. The fruits do not seem to be fixed as to type; berries of the shape of Bubach and Sharpless, and others that were conical, being found on the same plant, but never with the green tip of the Sharpless. Fruits firm enough to ship, and although not of the finest flavor, better than the average. We think well of this, and consider it a promising new sort.

Gipsey, Imp.— This variety is low and stocky in growth, produced well in stool row, and was fairly productive in matted rows; berries of medium size, firm and of good flavor.

Hulbert, P.—Of Sharpless type of growth and foliage. The fruit-stems are very stout, holding large clusters of good-sized conical fruits well up in foliage, thus keeping the fruits clean when not mulched; fairly productive, firm; pleasing, subacid.

Kimsey's No. 49.— A Kansas seedling of vigorous growth, but of only medium productiveness; quite firm and tart.

Louise "Burpees," P. — Plants grow finely; foliage light green; very clean and healthy; berries produced in large clusters, of good size and a bright showy scarlet. This is a very attractive berry, and, being firm and of excellent quality, should become popular.

Lincoln. — This proved fairly productive of large-sized fruits of Sharpless type, without green tips; firm and fine quality.

Marvel, P. — Of low stocky growth, with dark green foliage. This set a large quantity of fruit, but was badly affected by drought, the berries, especially in matted rows, shrivelled up; fruits firm, but subacid.

Minneola. — Growth low and stocky; foliage light green; fruits heart-shaped, hulls cling to berry very firmly; and when removed, bring with them a hard core from the fruits; not very productive, soft, but good flavor.

Mrs. Cleveland, Imp. — Of vigorous growth; gave a few very large berries; the balance were small fruits, soft but of fine flavor.

Michels Early, P. — This variety has been very extensively disseminated for trial, the claims made for it being extreme earliness and productiveness. The plants sent to this Station were among the finest ever received, and made a wonderful growth the first season, the plants in stool rows looking like bushes, those in matted rows forming so many runners that it was necessary to thin out the rows, and every indication pointed to a successful harvest at fruiting time. This spring the plants uncovered in fine form, bloomed early and set a large number of fruits, but did not ripen them earlier than several other varieties; the fruits were below medium size, of very poor color, too light to market, and very soft. The only good points it seems to have are its pollen bearing qualities, its good flavor and its ability to cover a large area with runners. On good light sandy soil it may prove of more value, but here it has been a failure.

No. 1, Imp.— A cross of Manchester and Miner's Prolific. Growth of plant, fine; foliage light green; bears large clusters of conical fruit, showy red in color, and above the average size, firm and good flavor, not very productive this year.

New Improved Manchester, P.— A seedling of the same cross as the above. Growth of plant stocky; the fruit is of Jersey Queen type and flavor, but darker than that variety. The fruits are hidden by the foliage, causing one to pass it by as not a very heavy yielder, but it is above the average in that respect; soft, but of a very fine flavor.

No. 19.— This variety, received from Delaware, is of very low stocky growth, with light green foliage; has large clusters of fruit borne on thick short stems; the fruits are in form, color and flavor a reproduction of the Jersey Queen, but average larger in size than the latter; they are firm enough to ship.

Ohio Centennial, Imp.— One of Geo. Townsend's seedlings of more than the average merit; fruits coxcombed, scarlet and of large size, firm and of fine flavor.

Oliver, P.— This is a very fine growing variety, making a fine bushy plant with showy green foliage; was not productive this year; fruits of Sharpless type, with the characteristic green tip of that variety, firm, with a pleasing subacid flavor.

Parker Earle, P.— With one year's fruiting of this variety, too much can not be said in its favor. The growth and habit of plant are perfect; its yield of fruit, while not up to the highest, is large, and the shape, uniformity of size, brilliant color and flavor combined, make a row of this variety appear the acme of strawberry growing; the fruits at first are green, then, just before ripening, a dead white, after ripening a glossy scarlet with yellow seeds projecting from fruits, each fruit having the appearance of being cut off square on the tip end. It has not the firmness of the Wilson, but we think will ship to near-by markets.

Pearl, P.— Not productive here.

Phillip's Seedling.— From Staunton, Ind. Is a variety of rank growth, with light green foliage; fruits borne on stiff fruit-stalks which, however, are not able to hold up the immense clusters of large berries; fruits resemble Sharpless without the green tip. The stool plants are enormously productive, and make a very fine display when the fruits are ripe. Firm and of fine flavor.

Shuster Gem, Imp.— This variety is well spoken of in some localities, but does not do well here; fails to make runners and produces but a small quantity of medium sized fruits.

Tippecanoe, P.— An improvement on Sharpless, more productive; fruits average larger, earlier and firmer.

Van Deman, P.— This is the best extra early variety ever tested on the Station grounds. The first picking of three quarts of any one variety were picked from this, and it continued in bearing for twenty-one days, ripening the bulk of its fruits, however, in ten days. The vigor of plants is good, growth stocky, and fruit hid beneath the dark foliage; berries a showy glossy scarlet with yellow seeds, firm and tart. We are of the opinion that this variety has a great future.

Of the varieties of strawberries tested for the second season, we will supplement our last report on them as follows:

Cloud.— This made a large quantity of runners, and in the spring looked finely, but suffered severely through drought, ripening but little fruit.

Felton, P.— About as last year. Its season is long; fruits of good size through picking, showy, firm, and of very fine flavor.

Gandy.— Slightly more productive than last year; fruits good size and firm; picking season from June twenty-five to July six.

Hinman.— This blighted worse than last year and will be discarded.

Itaska.— About as last year; has nothing special to recommend it.

Logan.— Nothing special to recommend it.

Lady Rusk.— This was more productive than last season, but the fruits run small, often being misshaped and, being a very dark berry, it does not rank with the first-class varieties.

Long John. — A failure, as last year; has been discarded.

Monmouth. — Also another failure this year.

Stayman's No. 1.— This did not stand the lack of moisture when setting its fruits, and fell behind its last year's record, but we think it a very good substitute for Crescent, and have faith that it will be extensively planted.

Stayman's No. 2. —The yield from this was slightly ahead of the No. 1 this year, but the fruits did not average as large, besides being soft.

Scarlet Gem. — A failure; has been discarded.

Viola. — Fruits very large, firm and of fine flavor, but not productive.

Windsor Chief. — Better than last year; a good garden variety.

Of the older varieties described in a previous bulletin, the best are: Burt's still in the lead; Haverland, one of the best if it was not so soft; Stayman's No. 1, while not as productive as last year, still among the leaders; Middlefield, Mount Vernon, Windsor Chief, Hoffman, and Bubach a No. 1. The Warfield was found to have become mixed with other varieties in consequence of which no report of it is made, but, from a large number of other reports, it would seem to be one of the popular market varieties. In Oswego county, one of the leading berry-growing sections of this State, the Burt, Eureka, Warfield, Cloud and Bubach are among the leading varieties grown, averaging, in New York and Philadelphia markets, from ten to twelve cents a quart net. The strawberry industry of that section has grown to such proportions that refrigerator cars are furnished at the leading stations through the height of the season, shipped on fast trains, reaching the markets in fine condition, thus obtaining the highest market price.

In the vicinity of Geneva the growing of strawberries has received an impetus by the establishment of a canning factory, a large acreage having been planted in the past year. This factory has canned this season over 45,000 quarts, sending to Monroe and Oswego counties for part of their supply. They would like to be supplied with at least twice that amount, and will pay about six cents per quart. Of course, one growing extra fine fruit, requiring special care, can not afford to sell at these prices, but, through the middle of the season, when it often happens that the markets of the trade centers are glutted, the ability to dispose of the over-supply makes the difference between profit and loss. The danger of overdoing the strawberry industry is in the distant future, and from observation and reports it has been universally found that those who grow the strawberry and other small fruits for a livelihood are those whose farms are paid for, whose bank accounts foot up on the right side and whose homes compare favorably with those of their neighbors.

We would not advise anyone to undertake the growing of small fruits for markets without some knowledge of their culture, and an undertaking of the varieties best adapted to his market, whether at home or abroad. Still we believe that a young man can start with limited experience, and, by profiting by failures gain in a few years the practical knowledge necessary to success;

and, if located near a first-class market, so as to be able to deliver directly to consumers, can, by raising the choice varieties, command the highest price for his fruits. For instance, one grower of this place, who delivers directly to private families, reports his lowest price this year as eighteen cents per quart. Of course, these were fancy fruits, carefully picked and in clean baskets, but there is no doubt that the care given increased his profits one-half. We should advise, if planting for a fancy market, the following varieties: Early, Haverland and Van Deman, medium season; Bubach, Sharpless and Burt's, for late; Crawford, Middlefield, Parker Earle and Gandy. If for distant market, Van Deman, Stayman's No. 1, Burt's. For near-by market, the last mentioned varieties with the addition of Beeder Woods, Parker Earle and possibly Mount Vernon.

Thus having Van Deman to pollenize Haverland; Bubach between Sharpless and Burt's; Middlefield between Parker Earle and Gandy. Most of these varieties have become so well known and so extensively propagated that they can be bought very reasonably, and they will increase so rapidly, that, starting with a few hundred plants, thousands can be had in a year's time, thus putting a beginning within the reach of almost anyone.

INSECT ENEMIES OF THE STRAWBERRY.

The insect enemies of the strawberry are numerous, although but few of them cause serious injury. Two of these pests that attack the root of the plant are the Strawberry Root-borer and the Strawberry Crown-borer. The first is a small caterpillar nearly half an inch long and of a reddish pink color. This borer eats irregular channels through the crown, often tunneling in various directions, eating its way to the surface. The caterpillar burrows into the heart of the plant and remains in one of the chambers during winter. In June it changes into a small reddish-brown chrysalis either in one of the cavities excavated in the crown or among decayed leaves or rubbish. The moth, which escapes in July is very small and of a dark gray color. This moth lays an egg on the crown of the plant late in July or early in August, which soon hatches and the caterpillar begins its depredations. The Crown-borer larva is a grub of about one-fifth of an inch long, white, with a horney-yellow head. The grub eats the substance of the crown and is very destructive. The remedies recommended for these borers are dusting the plants with air-slaked lime or hellebore; or spraying with Paris green. But as these borers feed on the inside of the plants, and, when first discovered, have usually ruined the plants, the best method is to dig up all infested plants and burn them. The insects attacking the leaves of the strawberry are the following: The strawberry leaf roller, the neat strawberry leaf roller, the smeared dagger, the cut-worm, the strawberry saw-fly and several others. Only those mentioned are, however, considered numerous enough to cause much damage, and the remedies usually used are the same for all except the cut-worm, viz.: powdered hellebore and water in the proportion of an ounce of the hellebore to the pailful of water; Paris green and water, one teaspoonful of Paris green to two gallons of water. Either of these remedies have been proven of benefit, and, if not used while the fruit is on the plants, they will cause no injury.

The only disease of the strawberry that causes much damage is the leaf blight which is very prevalent in some years. The most efficacious remedy found for it has been the ammoniated carbonate of copper, sprayed on the vines after fruiting.

Strawberries — The Most Productive Twenty-six in Order of Productiveness, Season of 1891.

Stool Row.	*Matted Row.*
Beeder Woods.	Burts.
Phillip's Seedling.	Beeder Woods.
Gipsey.	Greenville.
Van Deman.	Parker's Earle,
Parker's Earle.	Phillip's Seedling.
Haverland.	Sou de Bossuet.
Crawford's Seedling.	Capt. Jack.
Edgar Queen.	Lyon's Seedling.
Smith's No. 77.	Lady Rusk.
Hulburt.	Lincoln.
Kimsey's No. 49.	Ohio Centennial.
Lincoln.	Mount Vernon.
Stayman's No. 1.	Haverland.
Greenville.	Lida.
Capt. Jack.	Windsor Chief.

Tippecanoe.
Stayman's No. 2.
Mrs. Cleveland.
Ohio Centennial.
Burts.
Eureka.
Mitchell's Early.
Lida.
New Dominion.
Sou de Bossuet.

New Dominion.
Hulburt.
Daisy.
Stayman's No. 1.
Stayman's No. 2.
Leonard's Seedling.
Van Deman.
Improved Manchester.
Edgar Queen.
Gipsey.
Tippecanoe.

The matted rows of Burts yielding at the rate of 11,344 quarts per acre. The Beeder Wood, 10,890 quarts. The Greenville, 8,394. The Parker Earle, 8,168, while the Tippecanoe, the twenty-sixth in point of yield, gave 4,990 quarts. If these were sold at the lowest factory prices (six cents per quart) the returns would be profitable, but there is always a market at better prices than the above for all first-class fruits.

These estimates are taken from rows twenty-four feet long and four feet apart. One often hears of a yield of 20,000 quarts per acre, and as high as 40,000 quarts has been claimed, but at this Station we have been unable to obtain any advance on the figures given as the yield of Burt's for this year. At this time it may be well to state that the strawberries under test here are grown precisely as they should be grown by the small fruit grower, the soil moderately rich and with clean cultivation, thus giving each and every variety the same opportunity to show its merits.

RASPBERRIES.

Of the newer varieties of raspberries we have tested this year for the first the following:

Lovett's Early. This blackcap has made a very vigorous growth since planted, and this year gave a fair yield of fruit. It proves one of the earliest. Fruits firm and of good size. It gives promise of being a desirable acquisition, but it will need another year's test to be able to decide on its exact merits.

No. 101. A blackcap from Kansas. From the one plant of this variety that fruited the opinion was formed that this would become one of the best large fruited varieties. The fruits are very large, jet black, with very slight bloom.

Parry No. 1. This is an early red raspberry of rank growth and very dark foliage; fairly productive, soft, but good flavor.

Parry's No. 2. Later than the above by a few days, but a more abundant bearer; not as rank a grower; new canes have a reddish tinge and light green foliage. The berry is of large size, firm and of a distinct flavor. We think this will prove a valuable acquisition, as fruit has been picked from it for a season of forty days.

Quinby's Favorite. This variety resembles Cuthburt in growth of canes, with the exception of being practically thornless. The fruits are very large, deep red and very firm, but the firmness does not detract from the juiciness or flavor, which resembles Cuthburt in a marked degree.

Stayman's No. 5. A very rank growing variety, throwing up a large stool of canes; foliage light green; fruit large, dark red, firm, good flavor. One of the most productive varieties tested.

The earliest blackcap was the Carman, the latest the Ada. The most productive the Hilborn, with Smith's Prolific next.

Of the red varieties, the earliest were Clark and Thompson's Early Pride; the latest, Parry's No. 2, and Miller's Woodland. The most productive, Cuthburt, Muskingum, Shaffers, Clark, Thompson's Early Pride, Stayman's No. 5, Pomona and Genesee, in the order named.

The Caroline, an extremely hardy yellow variety, yielded more than any of the other varieties this year, and the Golden Queen, a Yellow Cuthburt, gave also a large yield. Both of these varieties are of superb flavor but soft and easily damaged because of their color. However, they should be in every private collection. The Shaffer is probably grown more extensively through sections where canning factories have been established than any other variety, as it is of a color that suits, and the yield is very large, growers being able to sell far below the price of the red varieties, and realize a handsome profit. One grower near Geneva picked this season from 2,550 bushes set three by eight feet (less than one and one-half acres) 6,839 quarts, selling at five cents per quart, thus realizing about $340. These bushes are now in full bearing, and will probably continue to yield at this rate for several years. For a shipping berry or one to be sold to consumers, the Cuthburt is still in the lead and seems to adapt itself to all localities and soils better than any of the newer varieties. In certain sections the Marlboro is grown with profit. The Clark does fairly well on some soils and is a fine colored and good flavored berry, much sought after for private canning. It and the Thompson's Early Pride will ripen fruit a week ahead of Cuthburt.

Of the blackcaps, probably the Gregg stands at the head, although in some sections is killed back in severe winter weather. It is eagerly sought after by the factories, and good prices are paid for it. It is a good yielder, berries showy and of good size. The same grower spoken of as growing the Shaffer has harvested this year from 2,400 Greggs 2,440 quarts, 1,300 of the plants being in their first year of bearing. The plants were grown three by six feet apart, making about one acre of plants. The fruit sold at canning factory for four cents per quart, about $100 an acre. The Ohio Souhegan and Palmer have also been planted to quite an extent, and as a berry for drying the Ohio stands at the head.

DISEASES OF THE RASPBERRY.

The raspberry has two troublesome diseases, the blackcap orange-rust and anthracnose. The former is to be dreaded from the fact that the only known remedy for it is to dig up all infested plants and burn them. The anthracnose, which attacks both the blackcaps and the red varieties, can be told by the blotched and cracked appearance of the canes and by the fruits drying up. This is being treated at this Station by a number of fungicides, and at the present writing there seems to be but little doubt but that Bordeaux mixture is having a beneficial action in preventing the spread of this disease.

INSECT ENEMIES OF THE RASPBERRY.

The insects attacking the raspberry are both numerous and troublesome, especially those attacking the canes. The first one to be described is the raspberry root-borer. This differs from the raspberry cane-borer in having sixteen legs, and resembles the peach-borer in its several stages. The moth of this borer has a body black banded and marked with golden yellow. Its wings when expanded will measure from three-quarters of an inch to an inch across. The eggs are deposited by the female during the hot summer weather on the canes a short distance above the ground. The young larva when hatched eats its way through the cane to the center where it feeds upon the pithy substance. It gradually channels the cane to the root, in which it spends the winter, forming, before the spring, cavities of considerable extent. As the spring opens, it makes its way up again, usually through the interior of another cane, to the height of five or six inches, where the larva, preparing for the exit of the future moth, eats the cane in one place nearly through, leaving only the skin unbroken. When full grown it is about an inch long, of a pale yellow color, with a dark brown head. When the time approaches for the moth to escape, the chrysalis which the borer has become, wriggles itself forward, and, pushing against the thin skin ruptures it, and forcing its way through the opening waits the escape of the moth. The injury done to the root is often followed by the death of the cane, which is sometimes incorrectly attributed to being the result of severe cold of winter. Little can be done with this pest other than uncovering the roots and cutting out the infested portions.

The raspberry cane-borer in its larva state lives in the center of the cane, burrowing downward and often causing the death of the cane. The female moth deposits her egg in June by girdling the young cane near the top in two places, one ring being about an inch below the other and between the rings the cane is pierced and an egg thrust into it. The presence of this enemy is early detected by the sudden drooping and withering of the tips, and by removing all the withered tops down to the lowest ring, so as to insure the removal of the egg, these insects may be kept under.

The tree cricket. Probably this is the most troublesome insect affecting the canes of the raspberry. The female cricket lays her eggs in the autumn by thrusting her long ovipositor obliquely more than half way through the cane, and down the opening thus made she places an egg. A second one is then placed alongside of the first and so on until from five to fifteen eggs are placed in a row. An irregular row of punctures indicates the presence of the eggs. These punctures weaken the canes, causing them to break very easily. The infested canes should be cut out and burned. The canes can often be told by a partial splitting which indicates the presence of these eggs. These crickets also injure the canes of the blackberry. The raspberry saw-fly, the raspberry apatela and the raspberry plume-moth all attack the leaves, and like all other leaf-eating insects can be subdued by the application of hellebore and water or Paris green.

THE BLACKBERRY.

Of the varieties tested on the Station grounds the Agawam and the Erie have given the best results, the former giving large yields of medium sized fruits, the latter yielding a fair crop of extremely large fruits. Their season is about the same, and, in order to lengthen out the season, it would be better to plant an earlier variety if one can be found that will flourish on the same soil. Next to the above we should place the Snyder, which, in fact, is more generally grown at present than either of the others. The Kittitiny, if hardy and free from rust, would be the perfection of blackberries, but only in a few favored localities can it be grown. The insect enemies of the blackberry are about the same as these of the raspberry, and an extended account of them is not necessary.

CURRANTS.

Of currants, the standard varieties are Fay's Prolific, Cherry and Prince Albert for reds, and the White Dutch and White Grape for whites.

The Fay's Prolific is certainly a very fine variety, growing in a fine compact bush, bearing heavy crops of extra large bunches of very large fruits. On light soils it is far ahead of the Cherry currant, but we have seen the Cherry, growing in heavy clay, when, but for the difference in the foliage, they would have been pronounced Fay's.

The Prince Albert is an excellent late currant, with distinct dark green foliage. The leaves are more pointed than those of any other variety, the fruit stems extra long and the fruit of fair size. The fruit ripens about three weeks later than either Fay's Prolific or Cherry currant, lengthening the season about six weeks, as the fruit hangs on the bushes for a long time before becoming unfit for use, as the foliage completely covers the bunches. Care should be taken in purchasing this variety, as there is a spurious strain of it in the market with the same foliage and habit of growth, but with short bunches and small fruits. Of the white varieties, the White Grape takes the lead, and, all things considered, is the only one necessary to grow.

Insect Enemies of the Currant.

The insects attacking the currant are the imported currant-borer, the American currant-borer, the imported currant-worm, the native saw-fly and several others of more or less importance. The two borers are in some sections a serious impediment to successful currant culture. The moth of the imported borer lays its eggs in June, singly, near the buds, where in a few days they hatch into small larva, which eat their way to the center of the stem, where they burrow up and down, feeding on the pith all through the summer, enlarging the channel as they grow older, until at last they have formed a hollow several inches in length. When full grown the larva is whitish and fleshy, with brown head and legs and a dark line along the middle of its back.

When the hollow stems do not break off, indications of the presence of the borer may be found in the sickly look of the leaves and the inferior size of the fruits.

The only remedies are to cut out and burn all hollow canes, or to capture and destroy the moths, who are sluggish in the cool of the morning. The American currant-borer differs from the above in being of smaller size and without feet. Sometimes as many as eight or ten of the borers are found within one cane. The cutting and burning of the infested stalks is recommended in this case as for the imported borer.

The insects attacking the leaves of the currant are the imported and native currant-worm, and the currant span-worm. There are numerous others that commit depredations of minor importance, but these three are all that are likely to be troublesome. The first two can be kept in subjection by the use of powdered hellebore, in the proportion of an ounce of hellebore to a pail full of water, sprinkled or sprayed on the bushes at their first appearance. For the span-worm, if hellebore is used, the liquid should be made three times the usual strength. Paris green is more certain and effectual where there is no objection to its use.

GOOSEBERRIES.

The varieties of gooseberries grown on these grounds comprise both the natives, such as Houghton, Mountain Seedlings and Smith's Improved; and those of foreign blood, as Industry, Triumph, Wellington's Glory and Roesch's Seedling, and at fruiting time the comparison between the two varieties was so marked that they would almost appear as plants of a different species. The foreign varieties have been kept entirely free from mildew this year by the early spraying of the plants, and at the time the fruits were ripe the plants were loaded with clean bright fruits. They were the admiration of all who saw them. The plants gave an average of over ten pounds of fruit, which would make it a profitable crop to grow.

VEGETABLES.

DESCRIPTION OF BEANS.

Of the new varieties of beans tested, the *Aroostook* possesses merit in regard to the large number of pods which each plant produces. These pods make a very good snap bean, and also are well filled with beans of medium size, white.

The *Early Warwick* matures early, furnishing snap beans for a short time early in the season. The beans are dark brown, slightly mottled.

Englefontaine.— A French variety, is very productive, furnishing a large number of snap beans, and maturing a large white bean of fine appearance.

Ronceray.— Green seeded. Also a French variety of very great merit as a snap or string bean. The pods are of good length, broad and very crisp, and continue to develop on the plants for a long period. The beans are long, rather flat, and of a greenish white.

Burpee's Bush Lima.—Plants of this variety made a very vigorous growth, the bushes being of immense size; the leaves are the shape and color of Pole Lima and without the glossy dark green on the other dwarf varieties. Plants were loaded with bloom and had quite a number of pods containing beans of edible size when killed by frost. In sections where the season is longer it will undoubtedly prove of value.

Jackson's Wonder.— Growth and general appearance of plants identical with Henderson's Dwarf Lima and Dwarf Carolina. Beans same shape and color as the dark type of Dwarf Carolina, but larger. Evidently a selection of that variety.

BUSH BEANS — TABLE OF YIELD.

	Number of pods on ten plants.	Number of beans in 100 pods.
Aroostook	255	480
Early Warwick	190	525
Englefontaine	340	465
Golden-eyed Wax	220	505
Rust Proof	170	440
Ronceray Green Seeded	150	375
No. 40	245	480
Dwarf Lima beans:		
Burpee's Bush	750	285
Dwarf Carolina	1,382	320
Henderson's Dwarf Lima	525	290
Jackson's Wonder	915	280
Sieva	950	285

In an experiment with beans as to the effects of fertilizers, the test has been made as to the susceptibility of the bean to the absence of potash, an old-time theory. It will be seen by the accompanying table of one-twentieth acre plats that the sulphate of potash gave the largest yield, with the plat that received nothing a close second, while muriate of potash, nitrate of soda and bone-black gave practically the same results. As these plats were all given the same treatment last year, it is unlikely that section twelve could have had any advantage in the soil over the balance of the sections, and as sulphate of potash contains a less per cent. of potash than the muriate of potash, it would seem as though the potash does not affect the crop so favorably as has been claimed. This experiment will be continued through a serious of years in order to test this matter thoroughly.

FERTILIZER EXPERIMENT WITH BEANS.

PLAT C.	Fertilizer.	YIELD.		Estimate per acre, bushels.
		Pounds.	Ounces.	
Section 9......	Bone black...........	49	5	18⅓
Section 10......	Sulphate potash	79	6	28
Section 11......	Nitrate soda..........	61	5	22⅓
Section 12......	Check	67	8	25¾
Section 13......	Muriate potash.......	61	....	20⅓

LETTUCE.

Blond Blockhead. — A light yellow variety with edge of leaves scalloped, outside leaves loose; head spiral, fine yellow leaves and midrib not very solid; goes to seed slowly.

Burpee's Blockhead. — A cabbage variety; outer leaves bronzed on edge; head solid, well blanched; apt to seed early.

Child's Half Century. — A dark green cabbage lettuce; very few outer leaves; heads small and loose, center golden; very crisp.

Denver Market. — A close growing variety with wrinkled leaves, outer ones light yellow, inner ones white; heads loose and tender.

Grand Rapids Forcing. — A beautiful fringed variety making very large plants of loose leaves without head; one of the most showy and quick growing kinds.

Gold Nugget. — A large-leaved variety; outer leaves loose; crisp; seeds early.

Large White Summer Cabbage. — Heads very compact, outer leaves light yellow, heart a beautiful golden color; crisp and without any bitter taste; a very fine variety.

New Premium Cabbage. — A low-growing variety; outer leaves smooth light green; heads compact and very tender.

Rawson's New Hot-house. — A small rapid-growing variety; goes to seed too early for summer use, except for extra early.

Paris White Cos. — White Long Standing and Trianon are of the Cos type, and appear to be identical.

All Year Round is a small heading variety with bright yellow leaves, very tender and crisp, but goes to seed very early in the season.

ONIONS.

Seeds of three varieties of onions were sown April 14, primarily to test the benefit of nitrate of soda as a fertilizer. Two of these varieties were from two sources.

Southport Yellow Globe.	Eastern grown seed.
Southport Yellow Globe.	California grown seed.
Southport Red Globe.	Eastern grown seed.
Southport Red Globe.	California grown seed.

These seed were sown on the same day and under identical conditions, but when the young plants appeared it was found that less than five per cent. of the eastern grown seed had germinated, while over ninety per cent of the California grown seed made plants. This is a startling difference, due probably to the eastern grown seed being over one year old. But as the months of April and May were exceptionally dry, the difference may be due to the California seed having more vigor than the eastern grown. As it has been demonstrated at this Station that cabbage and cauliflower seed grown on the western coast often develop larger and more vigorous plants than either eastern grown or imported seed, a comparative germination test of these seeds will be made at an early date. On May sixteenth nitrate of soda was applied to every alternate row of three varieties of onions by scattering it close up to the onion bulb at the rate of about 100 pounds per acre. This amount was applied twice afterward at intervals of thirty days. The results after the second application was very marked, the tops of onions being of a darker green color and of larger size. When these onions were harvested they were weighed with the tops on them and then the tops were cut off and weighed. The results are given in the accompanying table. It will be seen that the nitrate of soda caused a rank growth of tops at the expense of the bulbs, and was of no benefit as far as the merchantable yield was concerned.

ONIONS. TABLE SHOWING RESULTS OF APPLYING NITRATE OF SODA.

	FIRST ROW.—NITRATE OF SODA.			SECOND ROW.—CHECK ROW.			THIRD ROW.—NITRATE OF SODA.			Nitrate of soda. Weight of tops.		Check rows. Weight of tops.		Nitrate of soda. Weight of tops.	
	Number of bulbs.	Weight of bulbs.		Number of bulbs.	Weight of bulbs.		Number of bulbs.	Weight of bulbs.							
		Lbs.	Ozs.		Lbs.	Ozs.		Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
Prize Taker..................	196	50	12	203	57	8	186	56	8	3	12	1	10	3	1
Southport Yellow Globe.......	104	30	..	109	32	12	130	32	10	3	8	2	1	3	10
Southport Red Globe.........	205	40	4	192	43	10	134	35	12	3	14	3	..	3	8

DESCRIPTION OF THE NEWER VARIETIES OF PEAS.

Duke of Edinburg.— The plants grow to the height of five feet; leaves very large, mottled with white; pods three and one-half to four inches long, slightly wrinkled, each pod containing from four to six slightly oblong peas of good quality and large size. Season medium to late.

Heroine.— Plants four feet high, with small dark green foliage; pods usually borne in pairs, strongly recurved, containing an average of seven peas flattened on sides.

Henderson's First of All.— Plants half dwarf; foliage light green; pods borne in pairs, short, usually containing five peas. A good early smooth pea, maturing at one time.

New Giant Podded Marrow.— Plants three feet high; leaves small, light green, slightly mottled; pods usually borne singly, two and one inches long, containing usually six peas of medium size and of rather poor quality.

Shropshire Hero.— Plants three feet high; leaves large, light green; pods usually borne in pairs, strongly recurved, containing six large flattened peas; quality good and plants very productive.

Sutton's Satisfaction.— Plants three feet high; leaves small, light green; pods usually borne in pairs, recurved, containing five peas of very large size, of very fine flavor and quite productive.

The Mayor.— Plants three feet high; leaves small, very dark green; pods borne in pairs, three to four inches long, holding from five to six very large peas, slightly oblong; productive and of fine flavor.

The Don.— Plants four feet; leaves large, light green, mottled; pods borne singly, three inches long, holding five extra large peas slightly flattened on end; quality good.

The Admiral.— Plants four feet; leaves large, light green; pods usually borne singly, holding five small peas very much flattened on end; very productive and fine flavor.

The peas tested this year show renewed energy on the part of originators, either in crossing or by selection, as nearly every variety had merit, and several of them were exceptionally good. I should recommend the following as amongst the best: Admiral and Don for early, Heroine for medium season and the Mayor for late. These will give a six to eight weeks' succession.

PEAS.— TABLE OF YIELD.

	Number of pods on ten plants.	Number of peas in 100 pods.	Date of edible maturity.	Number of days from planting.
Angel's Premier	40	700	June 20	67
Burpee's Quality	97	430	June 22	69
Chelsea	50	580	June 18	65
Champion of England	185	510	July 4	81
Duke of Albany	130	415	June 18	65
Henderson's First of All	50	500	June 13	60
Heroine	60	740	June 25	72
Lightning	60	530	June 15	62
Nott's Excelsior	30	600	June 16	63
New Giant Podded Marrow	45	555	June 25	72
Sutton's Satisfaction	85	415	June 26	73
Station	50	450	June 13	60
Shropshire Hero	85	650	June 25	72
The Admiral	70	580	June 15	62
The Don	55	550	June 15	62
The Mayor	45	510	June 29	76

DESCRIPTION OF THE NEWER VARIETIES OF POTATOES.

Arizona.— Medium early; tubers long; skin pink; eyes deep; not productive.

Bill Nye.— Early; tubers long; skin white; eyes near surface; not productive.

Burpee's Extra Early.— Tubers flat; skin white; eyes deep; fairly productive.

Badger State.— Medium late; tubers long; skin white; eyes near surface; very productive.

Chicago Market.— Early; tubers flat; skin pink; eyes near surface; fairly productive.

Dandy.— Early; tubers long; skin white; eyes near surface; fairly productive.

Early Puritan.— Early; tubers rounding; skin pink; eyes deep; fairly productvive.

Fill Basket.— Late; tubers long; skin white; eyes deep; one of the most productive.

Freeman.— Extra early; tubers flat; skin white; fairly productive.

Gov. Rusk.— Medium season; tubers flat; eyes deep; fairly productive.

Green Mountain.— Late; tubers long; skin white; eyes near surface; one of the most productive.

Hall's Peachblow.— Late; tubers flat; skin pink; eyes deep; not productive.

Harbinger.— Medium season; tubers long; eyes deep; not productive.

Monroe Seedling.— Late; tubers long; eyes near surface; very productive.

Negro.— Late; tubers long; skin deep purple; eyes near surface; not productive.

New Queen.— Medium season; tubers long; skin white; eyes deep; fairly productive.

Ottawa Rose.— Early; tubers flat; skin pink; eyes deep; fairly productive.

Ohio Junior.— Early; tubers long; skin pink; eyes deep; not productive.

Pride of Ireland.— Late; tubers flat; skin white; eyes near surface; very productive.

Polaris.— Medium season; tubers long; skin white; eyes deep; fairly productive.

Randall's Beauty.— Medium late; tubers flat; skin pink; eyes deep; fairly productive.

Rural Blush.— Medium late; tubers flat; skin pink; eyes pink; very productive.

Snow Queen.— Late; tubers flat; skin white; eyes deep; fairly productive.

Seneca Red Jacket.— Late; tubers long; skin red; eyes deep; very productive.

Seneca Beauty.— Medium late; tubers long, with red skin and deep eyes; productive.

Summit.— Medium early; tubers long, with pink skin and deep eyes; fairly productive.

The Vaughan.— Early; tubers flat, with white skin and deep eyes; fairly productive.

Vick's Champion.— Late; tubers flat, with white skin; deep eyes; productive.

Vick's Early.— Early; tubers long; skin white; eyes deep; not very productive.

Vick's Perfection.— Late; tubers long; skin white; eyes deep; very productive.

White Prize.— Early; tubers long; skin white; eyes deep; not productive.

White Superior.— Medium early; tubers flat; skin white; eyes deep; fairly productive.

Woodbury's White.— Medium early; tubers long; skin white; eyes deep; fairly productive.

Wilson's First Choice.— Medium early; tubers long; skin white; eyes shallow; not productive.

COMPARATIVE TABLE OF YIELD OF THE NEWER VARIETIES OF POTATOES FROM TWO POUNDS OF SEED OF EACH, CUT INTO TWENTY TWO-EYE PIECES AND PLANTED ONE PIECE IN EACH HILL, HILLS TWO FEET APART, ROWS, THREE FEET

	Number merchantable tubers.	Weight merchantable tubers.		Number small tubers.	Weight small tubers.		Total number of tubers.	Total weight of tubers.	
		Lbs.	Oz.		Lbs.	Oz.		Lbs.	Oz
Arizona	166	47	5	46	3	4	212	50	9
Bill Nye	193	44	8	47	6	12	240	51	4
Burpee's Ex. Early	163	55	7	66	4	7	229	59	14
Badger State	166	68	8	18	2	2	184	70	10
Chicago Market	174	55	..	48	2	8	222	57	8
Dandy	177	54	..	34	4	13	211	58	13
Early Puritan	180	44	..	68	3	7	248	47	7
Early Market	123	44	14	18	1	3	141	46	1
Fill Basket	142	74	..	10	1	..	152	75	..
Green Mountain	173	88	8	26	2	4	199	90	10
Gov. Rusk	140	49	8	24	3	12	164	53	4
Harbinger	198	40	6	108	5	9	306	45	15
Hall's Peachblow	106	39	10	16	3	..	122	42	10
Monroe Seedling	174	55	..	48	2	8	222	57	8
Negro	243	46	8	44	2	5	287	48	13
New Queen	140	55	..	51	4	2	191	59	2
Ohio Junior	144	45	8	66	4	3	216	49	11
Ottawa Rose	173	39	..	41	3	4	214	42	4
Pride of Ireland	154	50	12	24	1	3	178	51	15
Polaris	163	58	..	62	4	10	225	62	10
Rural Blush	176	69	..	10	1	..	186	70	..
Randall's Beauty	140	53	6	42	2	..	182	55	6

COMPARATIVE TABLE OF YIELD OF THE NEWER VARIETIES OF POTATOES, ETC.—(*Concluded*).

	Number merchantable tubers.	Weight merchantable tubers.		Number small tubers.	Weight small tubers.		Total number of tubers.	Total weight of tubers.	
		Lbs.	Oz.		Lbs.	Oz.		Lbs.	Oz.
Stray Beauty	120	36	2	14	1	4	134	37	6
Snow Queen	160	47	8	49	3	8	209	51	..
Seneca Beauty	241	58	12	40	3	..	281	61	12
Seneca Red Jacket	135	64	..	6	..	10	141	64	10
The Vaughan	240	51	10	80	5	..	320	56	10
The Freeman, 1 lb	146	25	6	47	..	13	193	26	3
Vick's Champion	156	49	12	46	11	6	202	61	2
Vick's Early	110	39	..	41	3	4	151	42	4
Vick's Perfection	200	69	14	47	2	14	247	52	12
White Superior	155	52	12	34	1	12	189	54	8
Woodbury's White	175	56	..	34	1	4	209	57	4
Wilson's First Choice	189	46	10	32	2	1	221	48	11
White Prize	176	42	4	123	6	5	299	48	9

RESULTS OBTAINED BY SPRAYING WITH FUNGICIDES FOR THE PREVENTION OF POTATO BLIGHT.

On July ninth, before the appearance of blight, spraying experiments were started to note the effectiveness of the two best known and popular fungicides, viz., Bordeaux mixture and ammoniacal solution in their power to keep in check this disease. On that date an application was made of a mixture called liquid copperdine, a manufactured article sent out by one of the leading fertilizing chemists and claimed to be made from the United States Department formula for the ammoniacal solution. After using this mixture it was found by analysis that it was of but one-fourth the strength of the department formula and its further use on potatoes was discontinued and the ammoniacal solution of standard strength used in comparison with Bordeaux mixture. These remedies were applied with a Field Force Pump Company's knapsack sprayer, using a Vermorel nozzle to every alternate fifth row of potatoes, commencing at the first and third row, thus leaving every other row as check. This was done on a plat of White Star potatoes measuring six-tenths of an acre, the application being repeated at intervals of three weeks, with results as given in potato Table No. 1. By the middle of August almost every vine on rows not sprayed showed the effects of blight, while those sprayed either with Bordeaux mixture or ammoniacal solution were green and vigorous. At the time of harvest, the latter part of September, each row that had received treatment could be plainly distinguished.

On July thirty-first a square of thirty-six feet was staked off in the center of a quarter-acre plat of late planted potatoes, and the vines within the square sprayed with Bordeaux mixture three times at intervals of two weeks. By the middle of August the entire plat surrounding this square showed signs of blight, while the sprayed square continued growing. When the main crop of potatoes were harvested this plat was left in order to see how long the vines of the sprayed portion would resist the attack of the fungus. On October sixth the sprayed vines had turned brown and died out but probably from natural causes, as no signs of mildew could be seen. The entire plat was then harvested, and a comparison of the yield of sprayed versus unsprayed vines made in the following manner, the sprayed square containing 288 hills:

seventy-two hills, or one-fourth that number, were staked off on each side immediately surrounding the sprayed square, thus obtaining the same conditions as regards the previous treatment of the soil. The results of this test will be found in potato Table No. 2.

It will be seen that the sprayed portion gave a larger number of both merchantable and small tubers, but a larger per cent. of merchantable than small; also that the sprayed section had less than .29 of one per cent. of decayed tubers against about two per cent. from the unsprayed. The average weight of merchantable tubers from the sprayed section was 6.49 ounces as against 5.74 ounces from the unsprayed, showing that the benefit of spraying lay in keeping the vines in a healthy growing condition until the tubers had obtained their normal size. While the unsprayed section shows a very low per cent. of decayed tubers, the probabilities are that had the conditions that prevailed through July, when the blight made its appearance continued through August and September, a large part of the crop would have been decayed.

Through July the average maximum temperature was 76.5° F., with 3.52 inches of rainfall, conditions favorable to the blight. In August the average temperature was 78.5° F., with but 3.16 inches of rain; and in September the average temperature was 77.8° F., with but .47 inches of rainfall, creating unfavorable conditions for tubers to decay. While in 1890, when a large per cent. of the potato crop of this section decayed, the conditions were entirely different, the average maximum temperature for July being 80° F., for August 77.6° F., for September 69° F., with a rainfall for those months of 1.07 inches for July, 4.34 inches for August, and 5.81 inches for September, making 4.07 inches more rainfall for those three months in 1890 than this year, with an average lower temperature. There is, therefore, but little doubt that the lower temperature, combined with the excessive rainfall of that year, was the active agent in causing the decay of the potato.

The conclusions drawn from this experiment seem to be that spraying with either Bordeaux mixture or ammoniacal solution should be practiced by potato growers. Even in a year of partial exemption from blight it would pay, as Table No. 2 shows an increase of forty-eight bushels per acre on the sprayed section over the unsprayed. It may be advisable to use the Bordeaux mixture in connection with London purple or Paris green when either of the latter are used for the potato beetle, as it has been discovered that dissolving either Paris green or London purple in the Bordeaux mixture prevents the damage to leaves so often caused by these arsenites, as the lime used in the Bordeaux mixture renders the arsenic insoluble.

The conclusion is also reached by the results obtained in Table No. 1 and by other spraying experiments, that the Bordeaux mixture has given better results this season than the ammoniacal solution.

SPRAYING POTATOES — TABLE NO. 1.

	Average number tubers per row.	Average weight tubers per row.
Bordeaux mixture, rows 1, 5, 9, 13 and 17....	1.038–2	318–1
Check, rows 2, 4, 6, 8, 10, 12, 14, 16, 18, 20...	989–5	286–6
Ammoniacal solution, rows 3, 7, 11, 15, 19....	1.052–0	309–

SPRAYING EXPERIMENT TABLE NO. 2.

Sprayed square of 288 *hills.*

Number merchantable tubers.	Weight in pounds.	Number small tubers.	Weight in pounds.	Decayed tubers.	Weight in pounds.
1,054	426	226	19	3	1

Unsprayed, 288 *hills.*

Number merchantable tubers.	Weight in pounds.	Number small tubers.	Weight in pounds.	Decayed tubers.	Weight in pounds.
1,004	360	189	18	20	10

In the table giving the results of fertilizers used on forced tomatoes it will be seen that in both cases where nitrate of soda was used the yield has been the greatest, and where used alone the best results have been obtained, but the muriate of potash used alone hastened the ripening of fruits above either the nitrate of soda or the combination of nitrate of soda and muriate of potash. But it will also be seen that the muriate of potash gave a larger average weight per individual fruit than the nitrate of soda, and the question of earliness and size of fruits as compared with quantity will have to be taken into consideration in the probable cost of producing and price of selling.

Table giving results of fertilizers used on forced tomatoes:

ATLANTIC PRIZE.

MURIATE POTASH.		NITRATE SODA.		MURIATE POTASH — NITRATE SODA.	
Number of fruits.	Weight in ounces.	Number of fruits.	Weight in ounces.	Number of fruits.	Weight in ounces.
6	16	9	25¼	14	21¾
		IGNOTUM.			
4	16¼	7	23¾	4	20¾
		No. 115.			
9	18¼	21	41¼	15	32¼
		LORILLARD.			
3	9¾	12	15¼	6	19¾
		TOTAL FOR ALL PLANTS.			
22	60½	49	105½	39	94½

Number plants.	TOMATO TABLE.	Average number of fruits per plant.	Average weight of fruits.	Yield First Half of Season.			Yield Last Half of Season.			First ten fruits ripe.	
				Number fruits.	Weight of fruits.		Number fruits.	Weight of fruits.			
			Ounces.		Lbs.	Ozs.		Lbs.	Ozs.		
5	Atlantic Prize	52	5½	164	59	½	106	34	¾	August	20
4	Chemin	68	4¾	80	25	4	195	60	¼	August	29
5	Cook's Favorite, No. 9	168	2¼	98	14	4	741	100	..	August	29
5	Cook's Favorite, No. 10	135	2¼	108	16	¾	576	80	..	August	29
5	Cumberland	77	5½	57	24	¼	329	110	..	September	8
3	Dwarf Champion	46	4½	15	4	..	131	32	..	September	8
5	Ignotum	45	7¼	28	13	..	200	88	..	September	8
4	Mansfield Tree	38	8¼	26	5	..	167	92	¼	September	11
4	Mitchell's New	78	6¼	25	12	¾	301	111	¾	September	8
4	Matchless	55	5¾	17	7	½	208	78	..	September	3
5	No. 115	124	3⅛	224	53	¼	396	84	..	August	29
4	No. 1	85½	5¼	195	67	..	232	63	½	August	29
4	No. 400	16½	11½	5	4	¼	79	67	..	September	14
5	Potomac	49	7¾	43	29	¾	202	96	..	September	8
5	Table Queen	32	6¼	42	16	½	110	43	½	September	3

It will be seen by this table that the heaviest individual fruits were produced by the No. 400. The largest yield of fruit per plant was from the Cook's Favorite No. 9. The earliest ten fruits from Atlantic Prize, which variety also ripened the largest part of its crop in the first-half of the fruiting season. The heaviest yield of fruits per plant was from the Mitchell's New.

DESCRIPTION OF NEW VARIETIES OF TOMATOES.

Mansfield Tree.— The vines of this variety grow very rank, and if trained to a stake might be called a tree, but with no more accuracy than many other varieties. The fruits are very large, of light purple color, very much flattened and wrinkled; flesh meaty. Not a desirable variety for market, the fruits being too large and not smooth enough to slice.

Mitchell's New.— Early, quite productive, and of medium vigor; fruits quite flat on blossom end; quality good.

No. 400.— Growth of vine vigorous; season late; moderately productive; fruits of the largest size, very symmetrical, purple in color; flesh firm.

Potomac.— Growth vigorous; moderately productive; fruits large symmetrical, blossom end flat, of a pleasing red; flesh firm and of fine quality.

Report of Farmer and Acting Pomologist.*

Nearly the entire time throughout the year has been given to routine work in orchards and on the general farm. The employment of and superintendence of the labor has been one of the duties of this department. Some of the more important work for the season in the line of improvement was the grading around the new laboratory and the laying of a vitrified tile sewer from the building to the creek, a distance of about sixty rods. Part of the way it was necessary to excavate about seven and one-half feet in order to secure a uniform grade. A gravel road was built through the orchard, extending from those already completed around buildings to the highway on the west of the farm and a turn made, giving visitors an opportunity to drive through orchards.

The farm proper embracing fields south of creek not divided into plats for experiment has been devoted to crops best suited to furnish grain and forage that can be used to the greatest advantage in feeding experiment cattle and work horses. The rotation for the most part consists of corn, forage crops, oats and hay. Wheat is excluded from the rotation except for test of varieties, or when a failure of seeding occurs with oats, owing to drought.

A field in sod containing eleven acres was fitted for and planted to corn on June tenth and eleventh, the severe spring drought which prevailed through this section rendering it impossible to get ground in condition earlier. From the west end of this field twenty-one plats were laid off containing one-fourth acre each and devoted to experiments with four leading brands of fertilizers. The results were negative in character; in no case did the increased yield of crop pay for the cost and application of the fertilizer. The field will be sown to oats in the spring and the after effects of the fertilizer noted.

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*G. W. Churchill.

They will be given with the data obtained during the season of 1891. The yield of corn on this field was about ten tons per acre as cut for silo. It was harvested on the thirtieth of September, October first, second and third, 106 tons in round numbers being cut and packed in silo. Although the corn was planted later than it was considered possible to secure a crop of corn in this latitude, it fully matured and made exceptionally fine silage.

The field of alfalfa of about two acres sown for forage, although on some of the poorest land on the Station farm and badly seeded with narrow leaf plantain, furnished a good supply of very palatable and nutritious forage, being cut three times during the summer. The plant gives promise of standing the winter well, and is in much better condition than in the fall of previous year.

The small field of prickly comfrey, also on poor ground and not manured, has furnished green feed for seven bulls the greater part of the summer.

Oats and Canada peas were sown in succession to complete the soiling of the season. At the close of this year's work in soiling we are led to believe that we can maintain our animals on alfalfa, oats and peas and corn cheaper than on any combination of forage plants we have tested at this Station. If we were to recommend any crop in addition for this purpose, it would be rye sown in the fall for one cutting.

LARGE FRUITS.

APPLES.

The older grafts in the experiment orchard failed to fruit except in a few cases and these the older and well-known varieties like Keswick, Codlin, Primate and Ben Davis. The newer varieties grafted in 1888; and those in each year since to the present date are in a very promising condition of growth, but have not come to sufficient maturity to bear fruit.

Toward the close of September some of the largest seedling orchards in the State were visited with a view of obtaining some data as to the value of native wild fruit for improvement and cultivation. Many hundreds of these trees were inspected, the color, size and flavor of the fruits noted, and from these thirty-two were selected as worthy of further note and study. Specimens of the fruit were selected and brought to the Station and placed on exhibition. Many of the seedlings resembled well-known named varieties of apples in general cultivation, and nurserymen and fruit growers named many of the specimens from their close resemblance to such well-known sorts as Spitzenburgh, Northern Spy, Fallwater, Greening, Maiden's Blush, etc.

Cions of the thirty-two from which fruit was selected have been secured and placed in safe-keeping for grafting in bearing trees the coming spring. The object of this work is not only to test these seedlings for the qualities which they may possess in themselves, but also for work in cross-fertilization with named varieties in cultivation, growing of seedlings from vigorous native stocks, and such other work as may be suggested in the future tending toward the improvement of our varieties of the apple. The results of this work can not be obtained in one season or perhaps in one lifetime, but we believe it to be in one of the most promising lines of effort for the improvement of the apple, and reports of progress will be given in the future as the work progresses.

PEACH, PLUM, APRICOT.

Of these fruits but few of the newer varieties have been set long enough to bear sufficient fruit to warrant a report as to their probable value for general cultivation. As in the case of the apples first grafted at the Station many of the varieties are of the older ones in cultivation and were planted as standards by which to judge of the value of new varieties as they come into bearing. Many of these produced a full crop of fruit the past season. Rollingstone, Robinson, Potawatamie, Weaver and other of the native varieties of plum bore several specimens of fruits, but aside from their appearance, which is very attractive, they are of doubtful value for general culture in this locality. The same is true of the Russian apricots so far as tested.

DESCRIPTIONS OF SOME OF THE NEWER VARIETIES OF GRAPES.

Adirondack.—Clusters few, medium size, not shouldered; berries nearly round, medium, not as large as Concord, black; skin of medium thickness, firm, does not crack, light bloom; pulp yellowish white, melting, separating readily from seeds; seeds two to three; flavor peculiar, suggests the odor of port wine. Did not mildew.

Amber.— Not ripe September twenty-one.

Ambrosia.— Not fully ripe September twenty-one. Clusters few, small, short, not shouldered; berry roundish, flattened, quite large, white; skin medium thickness, does not crack, white bloom; flesh yellowish white, somewhat tough at center; flavor pleasant subacid; two to three quite large seeds.

Aledo.— Not ripe September twenty-one.

Arnold's No. 16.— Not fully ripe September twenty-one. Cluster not shouldered, small; berries nearly round, small, about like Clinton, black; skin thin, bloom lighter than berry; flesh green, texture medium, tender; flavor subacid; two medium-sized seeds. Did not mildew.

Black Eagle.— Cluster long, sometimes shouldered, quite large; berries longish, elongated, small to medium, largest not larger than Hartford, black; skin quite thin, with medium bloom; flesh green, yielding, separating easily from seeds of which there are from two to four; flavor pleasant, quite acid. Did not mildew.

Beagle.— Clusters medium, not shouldered, quite short and compact; berries nearly round, medium to small, black; skin rather thick, reddish purple on inside, very sweet when chewed, heavy bloom; flesh pinkish, rather firm, pulp inclined to meaty, pleasant subacid flavor; two to three medium-sized seeds. Did not mildew.

Brighton.— Cluster medium, compact, sometimes shouldered, medium to large; berries nearly round, size of Concord, reddish purple; skin of medium thickness, colors the fingers when bruised, bloom quite abundant; flesh whitish, quite yielding, separates readily from seeds, flavor pleasant but peculiar when pulp is broken; seeds two to six. Did not mildew.

Caywood No. 50.— Cluster compact, not shouldered, medium size; berries nearly round, size of Hartford, black; skin medium, heavy bloom. Not diseased.

Clevener.— Cluster medium, sometimes shouldered; berries small, nearly round; skin quite firm, colors the hands when broken, quite thin bloom; reddish purple flesh, quite firm, meaty, flavor like parent riparia; three to four medium-size seeds.

Clinton.— Cluster medium, shouldered, small; berries nearly round, small; clings well to pedicle; skin very thin, quite heavy bloom; flesh green on outside, purplish around seeds, firm, stringy, flavor like parent; one to three medium-size seeds. A little powdery mildew.

Cottage.—Cluster quite large, shouldered; berries nearly round, quite large, larger than Concord; color black; skin thick, very heavy bloom; flesh pinkish, tough but not stringy, flavor very pleasant, subacid when pulp is broken; three to four quite large seeds.

Croton.— Cluster long, shouldered, quite large size; berries slightly elongated but small; leaves somewhat rusted; color pinkish white; skin very thin, bloom quite light; flesh green, tender, and very melting and separates readily from the seed; flavor very pleasant, vinous if not rich; one to two seeds.

Creveling.— No fruit. A little anthracnose.

Daisy.— Cluster small, inclined to be loose; berries medium size, elongated like Isabella, color red; skin medium thickness; flesh whitish green, tough, does not separate readily from seed; flavor slightly foxy; seeds two to three, quite large. No disease.

Delaware.— No fruit.

Dracut Amber.—Cluster quite short and compact, not shouldered, small to medium; berries of medium size, roundish and a little elongated, color dark amber; skin very thick and meaty, impresses one as of more substance than the pulp; flesh greenish white, rather firm, does not separate easily from pulp, a little foxy; seeds three to four, quite large. No disease.

Early market.— Cluster medium size, quite compact; berries nearly round, small like Clinton, of black color; does not cling very well to pedicle; skin medium thick; flesh green, flavor very pleasant, sweeter than most of the wine grapes; two to three seeds, quite small. No disease.

Eldorado.—Clusters too imperfect to describe, very roundish, very much flattened, color yellowish white; skin quite thick, bloom scant; color of flesh whitish, very tender, separates from seeds readily, very pleasant, no foxiness; two to three seeds of medium size. No disease.

Elsingburgh.— No fruit.

Elvibach.— Cluster medium, compact, quite long, not shouldered berries nearly round, medium size, color black; skin medium thick, bloom quite heavy; flesh greenish, quite firm, wine flavor; two to three seeds. No disease.

Elvira.— Not quite ripe September twenty-one. Cluster very compact, quite short, often shouldered; berries nearly round, a little flattened, medium size, color white; skin medium thick; little bloom; color of flesh green; three to four seeds, good size. No disease.

Etta.— Not quite ripe September twenty-one. Cluster very compact, full square at the base, medium to large; berries nearly round, as large as Hartford, color greenish white; skin quite thin, little bloom; color of flesh greenish, texture quite yielding, separates from seed readily, flavor vineous; seeds, three to four. No disease.

Faith.— Cluster quite long, not shouldered, of medium size; berries nearly round, small, about like Jessica, yellowish or straw color; skin medium thick, with slight bloom; flesh white, fairly yielding, quite pleasant; seeds three, small.

Gœrtner.— See Massassoit.

Geneva.— Cluster medium long, rarely shouldered, of medium size; berries of medium size, inclined to oblong; color white, inclining to golden when fully ripe; skin medium thick with light bloom; color of flesh greenish white, separates quite well from seed, flavor fair; two to three seeds of medium size.

Gov. Ireland.— No fruit.

Grein's Golden.— Not fully ripe September twenty-one. Cluster rather loose; berries a little oblong, medium to large size, color red, same as Lindley; skin quite thick with slight bloom; color of flesh greenish; three to four seeds, quite large.

Greyson.— No fruit.

Janesville.— Ripens about with Moore's Earley. Cluster quite short and compact, sometimes shouldered; berries nearly round, about the size of Hartford, of black color; skin quite thick with heavy bloom; color of flesh dark red, around seeds, very firm, not softening when dead ripe; flavor very indifferent and quite acid when pulp is broken; three or four seeds of medium size. No disease.

Jewell.— No fruit.

Little Blue.— No fruit.

Mabel.— Clusters medium size and compact; berries round, averaging small, black color; skin quite thin, light bloom, color of flesh whitish, separates from seeds freely, wine flavor; two to three seeds of medium size. Free from disease.

Marion.— Cluster quite compact, shouldered; berries nearly round, medium size and of dark color; skin medium thick, with quite heavy bloom; color of flesh dark red, purplish around seeds, somewhat tough, does not separate easily, wine flavor; two to three seeds of good size.

Massassoit.— Cluster compact, sometimes shouldered, or large size; berries large and nearly round, red color; skin quite thin for so large a berry; color of flesh greenish white, quite melting, separates easily from seed, flavor good, resembling somewhat Salem; three to four large seeds. This variety resembles Gærtner in every respect.

Maxatawney.— Not ripe September twenty-six.

Merrimac.— Cluster medium size, compact but not shouldered; berry black, nearly round, and large; skin very thick, with heavy bloom; color of flesh whitish; pink around seeds, texture quite tough, separates indifferently, quite acid; two to three seeds, very large.

Metterny.— No fruit.

Missouri Reissling.— Cluster medium size, good length, sometimes shouldered; berries white, medium size, nearly round; skin quite thin, with slight bloom; color of flesh whitish, texture quite good, sprightly flavor; two to three seeds of medium size.

Nectar.— Cluster of medium to large size, quite long and compact, shouldered and double shouldered; berries black, of medium size and nearly round; skin medium thick with very heavy bloom; color of flesh yellowish white, texture very good when fully ripe, pleasant flavor; two to three quite large seeds.

Noah.— Cluster of medium size, sometimes shouldered; berries greenish, turning to yellowish white in sun, medium size and nearly round; skin quite thick, with little bloom; color of flesh greenish white, texture hard, flavor quite acid but sprightly; two to three seeds of medium size.

Northern Muscadine.— Clusters small, rather short and compact; berries reddish purple, medium size, and nearly round; skin thick, with slight bloom; color of flesh whitish, texture quite melting, flavor foxy; two to three seeds of medium size.

Olita.— Cluster long, quite loose; berries greenish white, small and nearly round; skin medium thick, with slight bloom; color of flesh greenish white, texture very yielding, dissolves in mouth, hardly any appearance of pulp, flavor pleasant, a little acid; two to three small seeds.

Red Bird.— Cluster quite long, sometimes shouldered; berries reddish purple, quite large, nearly round, a little flattened; skin thick, with thin bloom; color of flesh greenish white, texture quite firm, flavor foxy; two to three seeds of medium size.

Red Eagle.— Cluster inclined to long, not shouldered; berries dark red, of medium size and nearly round; skin quite thick, with heavy bloom; color of flesh yellowish white, texture quite good, separates readily; flavor very good, some foxiness; two to three seeds of medium size; a little mildew.

Pearl.— Not ripe September twenty-six.

Poughkeepsie.— Cluster quite long, not shouldered; berries red, nearly round, slightly larger than Delaware, quite heavy bloom; color of flesh, greenish white, texture very yielding, separates very readily, flavor sweet and sprightly; two to three seeds very small.

Profitable.— Cluster large, quite long, shouldered; berries greenish red, round, inclined to oblong; skin quite thick, with heavy bloom; color of flesh greenish white, texture very good, separates quite readily, flavor not pleasant; three to four seeds of medium size.

METEOROLOGY FOR 1891.*

The record of all the wind strong enough to turn a vane has been recorded accurately as to the direction and time.

The record of sunshine has been continued uniform with the first method adopted by Dr. Babcock, and a summary follows the record for 1891, showing a comparison of the sunshine for each year it has been recorded by the Neggretti and Zambra instrument.

The different tables follow in their order:

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* R. D. Newton in charge.

PRECIPITATION BY MONTHS SINCE 1882.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1882	....	....	....	....	....	3.69	2.42	2.37	1.25	0.62	1.22	0.55	....
1883	0.48	1.44	0.88	1.58	4.45	4.12	2.98	3.47	2.12	2.10	1.54	0.73	25.89
1884	1.83	2.01	2.54	0.83	2.49	2.01	2.33	1.44	3.17	1.67	1.01	0.97	22.30
1885	1.07	0.61	0.12	1.26	1.58	2.49	4.64	5.02	2.11	2.88	1.36	0.76	23.90
1886	1.13	0.95	1.13	4.13	1.92	2.92	4.41	2.86	2.31	1.39	3.48	1.24	27.87
1887	0.18	2.97	0.48	1.37	0.46	2.01	6.37	3.03	0.75	1.74	1.58	1.35	22.29
1888	0.78	1.04	1.43	3.09	2.79	3.88	0.99+	4.02	2.73	3.47	2.02	1.24+	27.48
1889	2.99+	0.25	0.66+	3.28	1.21	7.47	4.57	1.98	2.50	3.32	3.44	1.62	32.28
1890	2.16	1.45	2.16	2.20	5.49	5.26	1.07	4.34	5.81	4.54	2.40	....	36.88
1891	1.44	1.57	3.25	1.63	0.49	4.31	3.52	3.16	0.47	3.65	0.74	3.29	27.52

WIND RECORD FROM NOVEMBER, 1890, TO FEBRUARY, 1891.

DATE.	NOVEMBER.				DECEMBER.				JANUARY.				FEBRUARY.			
	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E to S.W.	Westerly, S.W to N.W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	....	....	....	22.0	22.0	....	......	2.0	....	5.0	22.0	......	....	....	18.0	6.0
2	....	....	17.0	4.0	8.0	....	......	10.0	....	....	24.0	......	10.0	....	......	13.0
3	....	....	4.0	19.0	3.0	....	10.0	......	19.0	....	......	4.0	....	5.5	17.0	......
4	3.0	....	2.0	2.5	......	....	8.0	16.0	1.5	....	......	......	....	....	......	24.0
5	....	....	6.0	9.0	......	....	......	11.0	2.0	....	......	14.0	7.0	....	13.0	4.0
6	....	....	18.0	1.5	......	....	8.0	......	1.0	....	......	23.0	....	....	24.0	......
7	2.0	....	14.0	......	......	....	5.0	16.0	....	....	......	24.0	....	....	......	3.0
8	10.0	....	5.0	......	5.0	....	3.0	......	....	....	......	24.0	4.0	13.0	2.0	......
9	4.0	1.0	11.0	......	......	....	10.0	12.0	....	....	......	13.0	3.0	....	11.0	......
10	11.0	....	13..	......	......	....	......	21.0	....	....	7.0	8.0	....	....	15.0	4.0
11	...	4.0	....	......	......	....	3.0	12.0	....	....	13.0	......	....	....	......	19.5
12	....	2.0	....	......	6.0	....	......	9.0	16.0	....	1.0	......	....	....	3.5	4.0
13	....	....	11 0	......	......	....	......	24.0	....	....	......	24 0	....	....	4.0	......
14	....	....	....	21.0	......	....	20.0	4.0	....	...	6.0	16.0	10.0	....	......	......
15	1.0	....	9.0	3.0	......	....	......	24.0	...	....	5.0	16.0	2.0	....	10.0	......
16	6.0	....	3.0	6.0	4.0	15.0	......	......	14.0	....	7.0	......	....	....	20.0	13.0
17	...	....	8.0	......	7.0	....	15.0	......	3.0	1.0	9.0	......	5.0	....	......	1.0
18	8.0	....	2.5	8.0	24.0	....	......	......	17.0	5.0	2.0	......	3.0	....	7.0	8.5
19	....	....	1.0	20.0	24.0	....	......	......	....	....	......	21.0	....	....	......	24.0
20	15.0	....	....	9.0	4.0	....	6.0	2.0	....	....	......	4.0	....	3.0	15.0	......
21	13.0	....	2.0	3.0	......	....	24.0	......	....	....	16.0	3.0	....	....	24.0	......
22	....	....	9.0	15.0	......	....	2.5	21.5	....	3.0	18.0	......	....	....	......	24.0
23	4.0	....	....	20.0	......	....	11.0	13.0	....	....	......	24.0	5.0	2.0	......	7.0
24	....	....	6.0	12.0	5.0	....	......	19.0	....	....	4.0	11.0	....	....	24.0	......
25	....	....	19.0	5.0	7.0	....	......	10.0	9.0	....	......	3.0	....	....	24.0	......
26	....	....	....	24.0	2.0	11.0	......	......	....	....	8.0	10.0	5.0	....	3.0	16.0
27	5.0	....	....	......	1.0	6.0	......	8.0	....	....	1.0	14.0	12.0	....	......	12.0
28	8.0	....	....	......	......	....	......	24.0	....	....	4.0	8.0	....	....	7.0	6.0
29	....	...	....	19.0	......	....	......	12.0	....	....	11.0	......	....	....	......	......
30	....	....	12.0	5.5	......	....	3.0	13.0	....	13.5	10.0	......	....	....	......	......
31	....	....	...	......	......	....	20.0	......	....	....	7.0	12.0	....	...	......	......
Total hours of movement	90.0	7.0	172.5	228.5	122.0	32.0	148.5	283.5	82.5	23.0	175.0	276.0	66.0	23.5	241.5	179.0
Per cent of time in each direction	18.1	1.4	34 6	45.9	20.8	5.5	25.3	48.4	14.8	4.1	31.5	49.6	12.9	4.6	47.4	35.1

WIND RECORD FROM MARCH TO JUNE, 1891.

DATE.	MARCH.				APRIL.				MAY.				JUNE.			
	Northerly, N.E. to N.W.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.E. to N.W.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.E. to N.W.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.E. to N.W.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	2.0	....	3.5	18.5	....	....	24 0	....	....	....	4.0	10.0	....	....	....	9.0
2	6.0	....	2.0	....	....	....	24.0	....	....	....	4.0	9.0	3.0	....	....	....
3	....	....	22.0	....	3.0	....	11.0	....	....	....	....	22.0	21.0	....	....	....
4	....	....	19.0	4.0	24.0	....	....	....	....	....	....	24.0	15.0	....	....	....
5	....	....	....	24.0	....	....	....	24.0	....	....	....	24.0	7.0	3.0	....	....
6	....	....	....	17.0	....	....	....	20.0	11.0	....	....	13.0	....	2.0	5.0	....
7	....	3.0	....	....	....	....	....	20.0	....	....	....	13.0	....	2.0	5.0	3.0
8	....	4.0	2.0	....	7.0	....	....	2.0	....	....	....	23.0	4.0	....	8.0	9.0
9	....	....	24.0	....	....	5.0	17.0	....	....	....	....	11.0	....	....	20.0	....
10	....	....	3.0	20.0	....	....	24 0	....	8.0	....	....	10.0	2.0	....	15.0	....
11	....	....	16.0	4.5	....	....	6.0	18.0	6.0	....	....	12.0	....	....	13.0	1.0
12	....	....	24.0	....	....	....	2.0	22.0	7.0	....	....	1.0	2.0	....	....	15 0
13	....	....	9.0	....	....	....	18.0	....	10.0	....	....	....	....	....	4.0	9.0
14	....	....	3.5	20.5	....	....	9.0	5.0	5.0		4.0	....	....	7.0	3.0	3.0
15	....	....	....	24.0	....	....	....	24.0	....	....	13.0	10.0	2.0	....	....	9.0
16	....	....	10.0	14 0	....	....	4.0	1.5	13.3	....	....	10.0	....	....	....	12.0
17	....	....	3.0	16.0	....	....	18.0	....	....	....	....	24.0	3.0	....	3.0	4.0
18	....	....	24.0	....	....	....	1.0	22.0	....	....	5.0	6.5	16.0	....	....	4.0
19	22.0	....	1.0	....	11.0	....	....	12.0	....	4.0	16.0	....	....	7.0	17.0	....
20	6.0	....	12.0	....	11.0	....	....	....	....	....	22.0	....	....	....	18.0	....
21	....	....	13.0	....	....	....	18.0	2.0	....	....	3.0	13.0	....	....	24.0	....
22	....	4.0	....	....	....	....	....	22.0	9.0	....	....	5.0	....	....	8.0	7.0
23	23.0	....	....	....	17.0	....	....	7.0	5.0	....	4.0	....	....	....	....	16.0
24	....	....	....	7.0	9.0	....	....	15.0	....	....	10.0	3.0	9.0	....	....	13.0
25	16.0	....	....	6.0	8.0	....	....	11.0	6.0	....	....	5.0	....	....	....	22.0
26	11.0	7.0	....	....	....	....	....	15.0	7.0	....	....	....	5.0	....	....	18.0
27	....	7.0	10.0	....	....	....	....	24.0	9.0	....	....	....	23.0	....	....	....
28	5.0	7.0	....	....	....	....	....	24.0	....	7.0	....	....	10.0	....	....	11.0
29	5.0	....	....	19.0	....	....	....	19.0	....	7.0	....	....	11.0	....	....	4.0
30	12.0	....	....	....	....	....	....	24.0	10.0	....	....	....	7.0	3.0	....	....
31	2.0	3.0	9.0	....	....	....	....	....	....	....	....	11.0	....	....	....	....
Total hours of movement	110.0	35.0	210.0	194.5	90.0	5.0	176.0	333.5	106.0	18.0	85.0	259.5	140.0	24.0	143.0	169.0
Per cent. of time in each direction	20.0	6.4	38.2	35.4	14.9	.8	29.1	55.2	22.6	3.8	18.2	55.4	29.4	5.0	30.1	35.5

WIND RECORD FROM JULY TO SEPTEMBER, 1891.

DATE.	JULY.				AUGUST.				SEPTEMBER.			
	Northerly, N.E to N.W.	Easterly, N. E. to S.E.	Southerly, S. E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.E. to N.W.	Easterly, N. E. to S.E.	Southerly, S. E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.E. to N.W.	Easterly, N. E. to S.E.	Southerly, S. E to S.W.	Westerly, S.W. to N.W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	......	6.0	......	6.0	......	......	5.0	8.0	......	......	6.0	5.0
2	......	......	13.0	2.0	10.0	......	......	4.0	......	......	17.0	......
3	......	......	24.0	......	9.0	......	6.0	......	......	......	17.0	......
4	......	......	4.0	20.0	3.0	8.0	......	......	......	......	12.0	8.0
5	......	......	......	24.0	......	......	5.0	......	13.0	......	......	......
6	......	......	......	24.0	9.0	......	......	......	......	6.0	14.0	......
7	......	......	3.0	8.0	3.0	3.0	......	2.0	......	......	......	19.0
8	5.0	......	2.0	13.0	......	.....	5.0	13.0	3.0	......	......	19.0
9	10.0	......	......	9.0	......	......	3.0	6.0	......	......	......	20.0
10	7.0	......	......	4.0	4.0	......	......	9.0	......	3.0	......	15.0
11	1.0	......	11.0	3.0	......	5.0	3.0	1.0	......	4.0	6.0	2.0
12	......	......	12.0	1.0	......	......	......	13.0	......	......	13.0	......
13	2.0	......	2.0	10.0	......	......	......	22.0	......	......	19.0	2.0
14	......	......	6.0	5.0	3.0	......	3.0	......	1.0	......	......	19.0
15	3.0	......	9.0	12.0	......	......	4.0	8.0	......	......	4.0	11.0
16	......	......	......	24.0	3.0	......	......	6.0	3.0	......	5.0	15.0
17	......	......	8.0	6.0	2.0	......	3.0	3.0	2.0	......	9.0	3.0
18	......	......	17.0	......	......	......	20.0	......	......	......	3.0	17.0
19	......	......	7.0	14.0	8.0	3.0	......	......	6.0	......	......	18.0
20	......	2.0	......	6.0	5.0	2.0	9.0	......	6.0	......	6.0	......
21	8.0	......	......	2.0	......	......	20.0	......	......	2.0	5.0	......
22	5.0	......	9.0	......	......	......	3.0	14.0	2.0	......	......	5.0
23	......	......	24.0	......	4.0	......	4.0	......	8.0	......	......	6.0
24	......	......	14.0	4.0	5.0	......	4.0	2.0	4.0	......	5.0	1.0
25	......	......	......	22.0	......	......	7.0	15.0	......	......	5.0	6.0
26	......	......	2.0	17.0	......	......	5.0	4.0	......	......	......	20.0
27	......	......	......	16.0	......	4.0	8.0	......	5.0	......	4.0	......
28	......	......	8.0	8.0	......	2.0	3.0	7.0	......	......	14.0	......
29	......	......	7.0	3.0	......	......	......	21.0	......	......	22.0	2.0
30	......	......	23.0	......	......	......	4.0	3.0	5.0	......	......	12.0
31	......	......	......	16.0	......	......	14.0	......	......	......	......	......
Total hours of movement	41.0	8.0	205.0	279.0	68.0	27.0	138.0	161.0	58.0	15.0	186.0	225.0
Per cent. of time in each direction	7.7	1.5	38.5	52.3	17.3	6.9	35.0	40.8	12.0	3.1	38.4	46.5

WIND RECORD FROM SEPTEMBER TO DECEMBER, 1891.

DATE.	OCTOBER.				NOVEMBER.				DECEMBER.			
	Northerly, N.E. to N.W.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.E. to N.W.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.E. to N.W.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	6.0	......	6.0	......	......	......	3.0	21.0	......	......	7.0	16.0
2	......	......	11.0	......	......	......	......	24.0	......	......	24.0	......
3	......	......	3.0	7.0	8.0	......	7.0	6.0	......	......	2.0	6.0
4	......	......	5.0	5.0	7.0	......	......	3.0	......	......	24.0	......
5	......	......	3.0	8.0	......	......	22.0	......	......	......	1.0	23.0
6	7.0	......	......	14.0	3.0	......	3.0	......	......	......	2.0	18.0
7	5.0	3.0	......	......	3.0	......	4.0	2.0	1.0	......	4.0	9.0
8	......	......	11.0	7.0	......	......	12.0	......	......	......	......	23.0
9	6.0	......	......	4.0	......	......	24.0	......	......	......	15.0	3.0
10	......	......	......	13.0	......	......	24.0	......	......	......	15.0	6.0
11	7.0	......	......	6.0	......	......	16.0	4.0	......	......	......	18.0
12	3.0	7.0	......	......	......	......	8.0	8.0	......	......	......	24.0
13	......	7.0	......	......	......	......	......	24.0	......	3.0	......	20.0
14	......	2.0	7.0	......	......	......	......	23.0	......	......	......	24.0
15	......	......	13.0	7.0	......	......	3.0	14.0	5.0	6.0	4.0	......
16	......	......	......	24.0	......	......	24.0	......	2.0	......	11.0	10.0
17	......	......	2.0	16.0	......	......	21.0	3.0	......	......	......	24.0
18	......	......	23.0	......	......	......	......	24.0	2.0	......	......	17.0
19	4.0	......	3.0	......	......	......	7.0	12.0	......	......	1.0	4.0
20	......	......	20.0	......	......	......	24.0	......	......	......	7.0	......
21	1.0	......	......	23.0	......	......	18.0	......	......	......	7.0	......
22	6.0	......	......	11.0	......	......	24.0	......	......	......	23.0	......
23	2.0	......	......	22.0	......	......	24.0	......	......	......	8.0	......
24	......	......	......	24.0	......	......	11.0	13.0	4.0	6.0	......	......
25	......	......	3.0	12.0	......	......	9.0	15.0	......	7.0	......	3.0
26	......	4.0	6.0	3.0	......	6.0	4.0	7.0	......	......	12.0	2.0
27	7.0	......	......	17.0	......	......	15.0	9.0	......	......	1.0	23.0
28	9.0	......	......	15.0	10.0	......	1.0	3.0	......	......	2.0	17.0
29	......	......	5.0	5.0	8.0	......	......	16.0	......	......	24.0	......
30	......	......	5.0	5.0	2.0	3.0	3.0	14.0	......	......	8.0	15.0
31	......	......	19.0	1.0	......	......	......	......	6.0	......	......	8.0
Total hours of movement	63.0	23.0	145.0	249.0	41.0	9.0	311.0	245.0	20.0	22.0	202.0	313.0
Per cent. of time in each direction	13.1	4.8	30.2	51.9	6.8	1.5	51.3	40.4	3.6	3.9	36.3	56.2

SUMMARY OF DIRECTION OF WIND FOR 1890–91.

	Northerly, N.W. to N.E.	Easterly. N.E. to S.E	Southerly. S.E. to S.W.	Westerly. S.W. to N.W.
November	90.0	7.0	172,5	228.5
December	122.0	32.0	148.5	283.5
January	82.5	23.0	175.0	276.0
February	66.0	23.5	241.5	179.0
March	110.0	35.0	210.0	194.5
April	90.0	5.0	176.0	333.5
May	106.0	18.0	85.0	259.5
June	140.0	24.0	143.0	169.0
July	41.0	8.0	205.0	279.0
August	68.0	27.0	138.0	161.0
September	58.0	15.0	186.0	225.0
October	63.0	23.0	145.0	249.0
November	41.0	9.0	311.0	245.0
December	20.0	22.0	202.0	313.0
Total hours	1097.5	271.5	2538.5	3395.5
Per cent. of time from each direction	15.0	3.7	34.8	46.5

SUNSHINE RECORD FOR 1891 BY NEGRETTI AND ZAMBRA INSTRUMENTS.

DATE.	JANUARY.												FEBRUARY.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs	m.	Hrs.	m.	Hrs.	m.
1	0	00	0	00	0	00	0	00	0	00	9	08	0	00	0	00	0	00	0	00	0	00	10	00
2	0	00	0	00	0	00	0	00	0	00	9	09	0	00	0	00	0	00	0	00	0	00	10	02
3	0	00	3	00	3	00	0	30	6	30	9	10	0	00	0	00	0	00	0	00	0	00	10	04
4	0	00	0	00	0	00	0	00	0	00	9	11	1	00	3	00	3	00	2	00	9	00	10	07
5	0	00	0	00	0	00	0	00	0	00	9	12	1	00	3	00	3	00	2	00	9	00	10	09
6	0	00	0	00	1	45	0	30	2	15	9	14	1	00	3	00	0	00	0	00	4	00	10	12
7	0	00	3	00	3	00	0	30	6	30	9	15	0	00	0	00	0	00	0	00	0	00	10	14
8	0	45	3	00	3	00	0	50	7	35	9	16	0	00	0	00	0	00	0	00	0	00	10	17
9	1	00	3	00	3	00	0	45	7	45	9	17	0	00	0	00	0	00	0	00	0	00	10	19
10	0	00	3	00	3	00	1	15	7	15	9	18	0	00	1	30	3	00	0	00	4	30	10	21
11	0	00	0	00	0	00	0	00	0	00	9	19	1	10	3	00	3	00	1	40	8	50	10	24
12	0	00	2	00	3	00	0	00	5	00	9	22	0	00	2	00	1	00	0	00	3	00	10	27
13	0	00	2	00	1	45	0	00	3	45	9	23	0	00	3	00	1	00	0	00	4	00	10	29
14	1	00	3	00	1	00	0	00	5	00	9	24	1	00	3	00	3	00	0	00	7	00	10	31
15	1	15	3	00	1	00	0	00	5	15	9	26	1	15	3	00	3	00	1	00	8	15	10	35
16	0	00	0	00	3	00	1	00	4	00	9	27	0	00	0	00	0	00	0	00	0	00	10	37
17	0	00	0	00	2	00	0	00	2	00	9	29	0	00	0	00	0	00	0	00	0	00	10	41
18	0	00	0	00	0	00	0	00	0	00	9	30	0	00	3	00	3	00	1	00	7	00	10	43
19	0	00	0	00	0	00	0	00	0	00	9	33	0	00	0	00	3	00	2	00	5	00	10	46
20	0	00	0	00	1	00	1	30	2	30	9	35	0	00	0	00	0	00	0	00	0	00	10	49
21	1	00	3	00	0	00	0	00	4	00	9	36	0	00	0	00	0	00	0	00	0	00	10	52
22	0	00	0	00	0	00	0	00	0	00	9	38	1	15	3	00	3	00	1	30	8	45	10	55
23	1	00	3	00	0	00	0	00	4	00	9	41	0	00	3	00	3	00	0	00	6	00	10	58
24	0	00	0	00	0	00	0	00	0	00	9	42	1	00	3	00	0	00	0	00	4	00	11	01
25	0	00	0	00	0	00	0	00	0	00	9	44	0	00	0	00	0	00	0	00	0	00	11	04
26	0	00	0	00	0	00	0	00	0	00	9	46	0	00	0	00	1	00	0	00	1	00	11	06
27	0	00	0	00	3	00	1	30	4	30	9	49	0	00	3	00	0	30	0	00	3	30	11	10
28	0	00	0	00	0	00	0	00	0	00	9	51	1	00	3	00	0	00	0	00	4	00	11	12
29	0	00	0	00	0	00	0	00	0	00	9	53	..	..	..	..	..	..	..	..	..	..	..	..
30	0	00	0	00	0	00	0	00	0	00	9	56	..	..	..	..	..	..	..	..	..	..	..	..
31	0	00	0	00	0	00	0	00	0	00	9	58	..	..	..	..	..	..	..	..	..	..	..	..
Total hours	6	00	31	00	32	30	8	20	77	50	294	12	9	40	42	30	33	30	11	10	96	50	296	05
Per cent. of possible	12.2		33.3		34.9		14.1		26.5		...	..	16.8		50.6		39.9		15.9		32.7		...	..

SUNSHINE RECORD—(*Continued*).

DATE.	MARCH.												APRIL.											
	Before 9 A. M.		9 to 12.		12 to 3		After 3 P. M.		Total hours.		Hours, sunrise to sunset.		Before 9 A. M.		9 to 12		12 to 3		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	1	00	3	00	3	00	1	20	8	20	11	15	0	00	2	00	0	00	0	00	2	00	12	42
2	0	00	3	00	1	00	0	00	4	00	11	17	0	00	0	00	0	00	0	00	0	00	12	46
3	0	00	2	15	3	00	0	00	5	15	11	20	0	00	0	00	0	00	0	00	0	00	12	48
4	1	30	3	00	3	00	1	00	8	30	11	23	0	00	0	00	0	00	0	00	0	00	12	51
5	0	00	0	00	0	00	0	00	0	00	11	25	1	30	3	00	3	00	2	00	9	30	12	54
6	1	00	3	00	2	00	0	00	6	00	11	28	1	30	3	00	3	00	1	30	9	00	12	56
7	0	00	0	00	1	00	0	00	1	00	11	31	1	00	3	00	3	00	1	45	8	45	12	59
8	0	00	0	00	0	00	0	00	0	00	11	33	0	30	3	00	3	00	1	00	7	30	13	02
9	0	00	0	00	0	00	0	00	0	00	11	36	1	00	3	00	3	00	0	30	7	30	13	04
10	0	00	2	00	3	00	2	00	7	00	11	39	0	00	0	00	0	00	0	00	0	00	13	08
11	1	30	3	00	3	00	1	00	8	30	11	42	0	00	0	00	0	00	0	00	0	00	13	11
12	0	00	0	00	0	00	0	00	0	00	11	45	0	00	0	00	0	00	0	00	0	00	13	13
13	0	00	2	30	0	30	0	00	3	00	11	48	1	00	3	00	3	00	1	30	8	30	13	16
14	1	30	3	00	3	00	1	00	8	30	11	51	1	30	3	00	3	00	0	00	7	30	13	19
15	1	15	3	00	3	00	1	30	8	45	11	53	0	00	0	00	0	00	0	00	0	00	13	21
16	0	30	2	00	1	30	1	00	5	00	11	56	1	30	3	00	3	00	0	00	7	30	13	24
17	1	30	3	00	3	00	2	00	9	30	12	00	0	00	0	00	0	00	0	00	0	00	13	27
18	1	45	3	00	1	30	0	00	6	15	12	03	0	00	0	00	0	00	0	00	0	00	13	30
19	1	30	3	00	3	00	2	00	9	30	12	05	0	00	1	00	1	45	1	00	3	45	13	33
20	0	00	0	00	0	00	0	00	0	00	12	08	1	00	3	00	3	00	0	00	7	00	13	35
21	0	00	0	00	0	00	0	00	0	00	12	11	1	30	3	00	3	00	1	00	8	30	13	38
22	0	00	0	00	0	00	0	00	0	00	12	14	0	00	1	00	2	00	1	30	4	30	13	40
23	0	00	0	00	0	00	0	00	0	00	12	16	0	00	0	00	1	00	0	00	1	00	13	43
24	1	30	3	00	3	00	2	00	9	30	12	19	1	30	3	00	3	00	1	45	9	15	13	45
25	1	45	3	00	3	00	2	00	9	45	12	22	1	45	0	00	0	00	0	00	1	45	13	48
26	1	30	3	00	3	00	2	00	9	30	12	25	1	45	3	00	3	00	2	15	10	00	13	50
27	0	00	0	00	0	00	0	00	0	00	12	27	0	00	3	00	3	00	2	30	8	30	13	54
28	1	30	3	00	3	00	2	00	9	30	12	30	1	45	3	00	3	00	2	30	10	15	13	56
29	1	00	3	00	3	00	2	00	9	00	12	33	1	00	3	00	3	00	2	00	9	00	13	59
30	1	30	3	00	3	00	2	00	9	30	12	36	1	00	3	00	3	00	2	30	9	30	14	01
31	0	00	0	00	0	00	0	00	0	00	12	39	..	..	..	..	..	..	..	..	..	..	..	..
Total hours	21	45	56	45	52	30	24	50	155	50	370	10	20	45	52	00	52	45	25	15	150	45	401	13
Per cent. of possible	24.8		61.0		56.5		25.7		42.1		....		20.7		57.8		58.6		22.8		33.4		....	

SUNSHINE RECORD — (*Continued*).

DATE.	MAY.												JUNE.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1.	1	00	2	00	1	00	0	00	4	00	14	06	1	30	2	30	2	00	1	30	7	30	15	05
2.	0	00	0	00	2	00	1	00	3	00	14	08	0	00	0	00	0	00	0	00	0	00	15	06
3.	0	00	0	00	0	00	1	00	1	00	14	11	0	00	0	00	1	00	0	00	1	00	15	08
4.	0	00	0	00	0	00	0	00	0	00	14	13	0	00	0	00	3	00	1	30	4	30	15	09
5.	0	00	0	00	0	00	0	00	0	00	14	15	1	30	3	00	3	00	2	00	9	30	15	09
6.	0	00	0	00	3	00	1	45	4	45	14	17	0	00	0	00	0	00	0	00	0	00	15	10
7.	1	00	2	00	2	00	0	00	5	00	14	20	0	00	3	00	3	00	2	30	8	30	15	11
8.	0	00	3	00	2	00	1	00	6	00	14	22	1	30	3	00	3	00	2	15	9	45	15	12
9.	1	40	3	00	3	00	2	30	10	10	14	25	1	45	3	00	3	00	2	30	10	15	15	13
10.	1	15	3	00	3	00	2	30	9	45	14	27	2	00	3	00	1	00	0	30	6	30	15	14
11.	0	00	0	00	0	00	0	00	0	00	14	29	2	00	3	00	3	00	2	30	10	30	15	15
12.	2	00	3	00	3	00	2	00	10	00	14	31	2	15	3	00	3	00	2	30	10	45	15	15
13.	1	30	3	00	3	00	2	00	9	30	14	33	3	00	3	00	3	00	3	00	12	00	15	16
14	1	00	1	00	3	00	2	00	7	00	14	35	3	10	3	00	3	00	3	15	12	25	15	16
15.	0	00	3	00	1	30	0	00	4	30	14	37	3	15	3	00	3	00	3	15	12	30	15	16
16.	0	00	0	00	0	00	0	00	0	00	14	39	2	30	2	00	0	00	0	00	4	30	15	17
17.	1	00	3	00	3	00	1	30	8	30	14	41	0	00	0	00	2	00	1	00	3	00	15	18
18.	0	00	0	00	0	00	0	00	0	00	14	43	0	00	0	00	0	00	0	00	0	00	15	17
19.	0	00	0	00	3	00	0	00	3	00	14	45	0	00	0	00	0	00	0	00	0	00	15	17
20.	0	20	1	00	1	00	0	45	3	05	14	47	0	00	0	00	0	00	2	00	2	00	15	17
21.	0	00	0	00	0	00	0	00	0	00	14	49	0	00	0	00	3	00	1	30	4	30	15	17
22.	0	00	0	00	0	00	0	00	0	00	14	51	0	00	2	30	3	00	0	00	5	30	15	17
23.	1	15	3	00	3	00	2	10	9	25	14	52	3	00	3	00	3	00	3	15	12	15	15	17
24.	0	00	0	00	0	00	0	00	0	00	14	54	3	00	3	00	3	00	3	15	12	15	15	17
25.	1	30	3	00	3	00	1	00	8	30	14	56	3	00	3	00	3	00	3	00	12	00	15	17
26.	0	00	0	00	0	00	1	00	1	00	14	57	3	20	3	00	3	00	3	00	12	20	15	16
27.	1	30	3	00	2	00	2	00	8	30	14	58	3	15	3	00	3	00	3	00	12	15	15	16
28.	0	00	2	00	2	00	1	00	5	00	15	00	3	00	3	00	3	00	3	00	12	00	15	15
29.	0	00	1	30	1	00	0	00	2	30	15	01	3	20	3	00	3	00	3	00	12	20	15	15
30.	0	00	3	00	2	00	1	00	6	00	15	03	0	00	0	00	0	00	0	00	00	00	15	15
31.	1	30	3	00	3	00	2	00	9	30	15	04	....		....		....		....		....		....	
Total hours	16	30	45	30	49	30	28	10	139	40	453	29	46	20	58	00	63	00	53	15	220	35	457	23
Per cent. of possible	12.2		48.9		53.2		21.4		30.8		...	..	33.5		64.4		70.0		38.5		48.6		...	..

SUNSHINE RECORD — (*Continued*).

DATE.	July.												August.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	2	30	2	30	3	00	2	45	10	45	15	13	0	00	0	00	0	00	0	00	0	00	14	26
2	0	00	0	00	2	00	0	00	2	00	15	12	3	20	3	00	3	00	3	30	12	50	14	24
3	0	00	0	45	1	30	2	00	4	15	15	12	3	30	3	00	1	00	0	00	7	30	14	22
4	2	45	3	00	1	00	1	30	8	15	15	11	0	00	0	00	0	00	0	00	0	00	14	20
5	1	00	2	00	0	00	0	00	3	00	15	10	0	00	0	00	1	15	2	15	3	30	14	17
6	0	00	0	00	1	00	0	00	1	00	15	09	3	00	2	45	3	00	3	30	12	15	14	15
7	0	00	0	00	0	00	0	00	0	00	15	08	0	00	2	00	2	00	0	00	4	00	14	13
8	0	00	0	00	0	00	0	00	0	00	15	07	1	30	2	00	2	00	0	00	5	30	14	11
9	3	00	3	00	3	00	3	00	12	00	15	06	0	00	0	00	0	00	0	00	0	00	14	08
10	3	00	3	00	3	00	3	15	12	15	15	05	2	30	3	00	2	45	2	00	10	15	14	06
11	3	00	3	00	3	00	2	50	11	50	15	04	3	00	3	00	2	00	0	00	8	00	14	03
12	2	45	3	00	3	00	3	00	11	45	15	03	0	00	0	00	1	00	2	30	3	30	14	01
13	3	00	3	00	3	00	2	00	11	00	15	01	2	45	3	00	2	00	0	30	8	15	13	59
14	3	00	3	00	1	00	0	00	7	00	14	59	3	00	3	00	3	00	0	00	9	00	13	55
15	1	30	3	00	3	00	2	00	9	30	14	58	1	00	1	30	2	00	3	00	7	30	13	53
16	3	00	3	00	3	00	3	15	12	15	14	56	3	20	3	00	3	00	0	00	9	20	13	50
17	2	00	2	00	3	00	1	00	8	00	14	55	3	30	2	30	1	45	0	00	7	45	13	48
18	0	00	0	00	0	00	0	00	0	00	14	54	2	00	2	45	0	30	3	15	8	30	13	48
19	3	15	3	00	3	00	3	20	12	35	14	52	2	30	3	00	2	00	3	00	10	30	13	45
20	3	00	3	00	3	00	3	15	12	15	14	50	3	00	3	00	3	00	2	30	11	30	13	43
21	3	20	3	00	3	00	3	10	12	30	14	48	0	00	0	00	0	00	0	00	0	00	13	40
22	3	00	3	00	3	00	3	20	12	20	14	46	3	30	3	00	3	00	2	00	11	30	13	38
23	0	00	2	00	3	00	2	20	7	20	14	45	0	00	0	00	0	00	0	00	0	00	13	35
24	0	00	1	00	0	30	0	30	2	00	14	43	0	00	0	00	0	00	0	00	0	00	13	33
25	3	00	2	00	3	00	0	00	8	00	14	41	2	45	3	00	3	00	3	00	11	45	13	30
26	1	30	0	30	0	15	3	10	5	25	14	39	2	00	2	00	3	00	2	00	9	00	13	27
27	2	50	3	00	3	00	2	00	10	50	14	37	3	45	3	00	3	00	3	15	13	00	13	25
28	2	45	3	00	3	00	1	45	10	30	14	35	3	00	3	00	3	00	2	50	11	50	13	22
29	2	00	2	00	2	00	2	15	8	15	14	33	2	30	3	00	3	00	0	30	9	00	13	19
30	0	00	0	00	0	00	1	00	1	00	14	31	2	30	3	00	2	45	1	30	9	45	13	16
31	3	00	3	00	3	00	3	20	12	20	14	28	2	45	3	00	2	30	0	00	8	15	13	13
Total hours	58	10	62	45	63	15	56	00	240	10	462	11	60	40	63	30	58	30	41	05	223	45	428	47
Per cent. of possible	42.9		67.5		68.0		39.7		52.0		...	..	51.0		68.3		62.9		33.5		52.1		...	..

SUNSHINE RECORD — (*Continued*).

DATE.	SEPTEMBER.												OCTOBER.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	2	30	3	00	3	00	2	00	10	30	13	08	2	00	3	00	3	00	1	45	9	45	11	43
2	2	30	3	00	3	00	2	40	11	10	13	05	1	45	3	00	3	00	2	00	9	45	11	40
3	1	45	3	00	3	00	1	45	9	30	13	02	1	00	3	00	3	00	2	00	9	00	11	38
4	0	00	0	00	0	00	0	00	0	00	13	00	0	00	2	30	2	00	2	00	6	30	11	35
5	0	00	0	00	0	00	0	00	0	00	12	57	0	00	0	00	1	45	2	00	3	45	11	32
6	2	00	1	45	0	45	0	45	5	15	12	54	1	00	1	30	0	45	0	00	3	15	11	30
7	2	15	3	00	2	30	0	30	8	15	12	51	0	00	0	00	0	00	0	00	0	00	11	27
8	1	30	3	00	3	00	2	00	9	30	12	49	0	00	0	00	0	00	0	00	0	00	11	24
9	2	00	3	00	3	00	1	50	9	50	12	46	2	00	3	00	3	00	0	45	8	45	11	21
10	2	15	3	00	3	00	2	10	10	25	12	43	2	15	3	00	3	00	2	15	10	30	11	18
11	2	30	3	00	3	00	2	15	10	45	12	40	0	00	0	00	0	00	0	00	0	00	11	15
12	2	15	3	00	3	00	2	00	10	15	12	38	2	45	3	00	3	00	2	15	11	00	11	13
13	0	45	1	00	0	00	0	00	1	45	12	35	2	45	3	00	3	00	2	15	11	00	11	10
14	0	00	1	30	1	00	1	30	4	00	12	32	2	30	3	00	3	00	2	30	11	00	11	07
15	0	00	0	00	0	00	0	00	0	00	12	28	0	00	0	00	0	00	0	00	0	00	11	04
16	0	00	0	00	0	00	1	30	1	30	12	26	0	00	0	00	0	00	0	00	0	00	11	01
17	1	45	3	00	3	00	1	45	9	30	12	23	2	00	3	00	3	00	2	00	10	00	10	58
18	1	45	3	00	3	00	1	50	9	35	12	20	2	00	3	00	3	00	2	00	10	00	10	55
19	1	00	3	00	3	00	2	00	9	00	12	17	2	00	2	30	2	00	1	00	7	30	10	52
20	2	00	3	00	3	00	2	00	10	00	12	14	0	00	0	00	0	00	0	00	0	00	10	50
21	0	45	2	30	2	30	0	15	6	00	12	12	1	30	2	00	2	00	0	30	6	00	10	47
22	2	00	3	00	3	00	1	30	9	30	12	09	0	00	0	00	0	00	0	00	0	00	10	45
23	2	00	3	00	3	00	0	30	8	30	12	06	2	00	3	00	3	00	1	30	9	30	10	42
24	1	15	3	00	3	00	1	45	9	00	12	03	2	30	3	00	3	00	1	45	10	15	10	37
25	1	30	3	00	3	00	1	45	9	15	12	01	0	00	1	30	3	00	2	10	6	40	10	36
26	1	00	3	00	3	00	1	40	9	40	11	58	2	00	2	45	3	00	2	00	9	45	10	34
27	1	30	3	00	3	00	1	30	9	00	11	55	0	00	0	00	0	00	0	00	0	00	10	32
28	0	00	0	00	0	00	0	00	0	00	11	51	2	00	3	00	3	00	1	10	9	10	10	29
29	2	00	3	00	3	00	2	00	10	00	11	49	0	00	0	00	2	00	2	00	4	00	10	26
30	2	00	3	00	3	00	1	50	9	50	11	46	1	00	3	00	3	00	2	00	9	00	10	24
31	..	..	..	..	..	..	..	..	..	..	..	..	0	30	1	00	0	00	0	00	1	30	10	21
Total hours	42	45	69	45	66	45	41	15	220	30	373	38	35	30	55	45	58	30	37	50	187	35	341	49
Per cent. possible	42.7		77.5		74.2		43.6		59.0		....		41.2		60.0		62.9		53.0		54.9		....	

SUNSHINE RECORD — (*Concluded*).

DATE.	NOVEMBER.												DECEMBER.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	0	45	1	00	0	00	0	00	1	45	10	19	1	20	3	00	3	00	1	00	8	20	9	17
2	0	00	0	00	3	00	1	00	4	00	10	16	0	00	2	00	2	00	0	00	4	00	9	16
3	0	00	0	00	0	00	0	00	0	00	10	14	0	00	3	00	1	00	0	00	4	00	9	15
4	0	00	0	00	1	00	0	00	1	00	10	12	0	00	2	00	2	00	0	00	4	00	9	14
5	0	00	0	00	0	00	0	00	0	00	10	10	0	00	1	00	2	00	0	00	3	00	9	13
6	1	00	3	00	2	30	0	00	6	30	10	08	1	20	1	00	0	00	0	00	2	20	9	11
7	1	30	3	00	3	00	0	30	8	00	10	05	0	00	3	00	1	00	0	00	4	00	9	10
8	1	30	3	00	3	00	1	45	9	15	10	02	1	00	3	00	2	45	0	00	6	45	9	10
9	1	00	3	00	3	00	1	00	8	00	10	00	0	45	3	00	2	00	0	00	5	45	9	09
10	1	30	2	00	0	00	0	00	3	30	9	57	1	15	3	00	3	00	1	00	8	15	9	08
11	0	30	1	45	3	00	1	30	6	45	9	55	0	00	1	15	3	00	0	00	4	15	9	07
12	0	00	0	00	0	00	0	00	0	00	9	53	1	15	3	00	3	00	1	00	8	15	9	06
13	0	00	0	00	0	00	0	00	0	00	9	50	1	30	3	00	3	00	0	45	8	15	9	06
14	0	00	0	00	0	00	0	00	0	00	9	48	0	00	0	00	0	00	0	00	0	00	9	06
15	1	30	3	00	1	00	0	00	5	30	9	46	0	00	0	00	0	00	0	00	0	00	9	06
16	0	00	0	00	0	00	0	00	0	00	9	44	0	00	2	00	0	45	0	00	2	45	9	05
17	0	00	0	00	0	00	0	00	0	00	9	42	0	00	0	00	0	00	0	00	0	00	9	05
18	1	00	2	00	2	30	0	00	5	30	9	39	0	00	0	15	2	00	1	00	3	15	9	05
19	2	00	3	00	3	00	0	30	8	30	9	38	0	20	2	00	0	30	0	30	3	20	9	04
20	0	00	0	00	0	00	0	00	0	00	9	36	0	45	2	00	0	00	0	00	2	45	9	04
21	0	00	0	00	0	00	0	00	0	00	9	34	1	15	3	00	3	00	1	00	8	15	9	04
22	0	00	0	00	0	00	0	00	0	00	9	32	0	00	0	00	0	00	0	00	0	00	9	04
23	0	00	0	00	0	00	0	00	0	00	9	30	0	00	0	00	0	00	0	00	0	00	9	04
24	0	00	0	00	0	00	0	00	0	00	9	29	0	00	0	00	0	00	0	00	0	00	9	05
25	0	00	0	00	1	00	1	00	2	00	9	27	0	00	0	00	0	00	0	00	0	00	9	05
26	1	30	2	30	0	00	0	00	4	00	9	25	0	00	0	00	0	00	0	00	0	00	9	05
27	1	30	3	00	1	30	0	00	6	00	9	24	0	00	3	00	1	00	0	00	4	00	9	06
28	0	00	0	00	0	00	0	00	0	00	9	23	0	00	3	00	0	00	0	00	3	00	9	06
29	0	00	0	00	0	00	0	00	0	00	9	20	0	00	0	00	0	00	0	00	0	00	9	07
30	0	30	0	30	1	00	1	00	3	00	9	19	0	00	0	20	0	30	0	30	1	20	9	07
31	..	..	..	..	..	..	..	..	..	..	..	..	1	15	3	00	0	30	0	00	4	45	9	08
Total hours	15	45	30	45	28	30	8	15	83	15	293	17	12	00	49	50	36	00	6	45	104	35	283	01
Per cent. of possible	24.5		34.2		31.7		16.6		28.4		....		23.0		53.6		38.7		14.5		37.0		....	....

MONTHLY SUMMARY OF SUNSHINE RECORD, MAY 1, 1885, TO JANUARY 1, 1892.

		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1885	Hours	......	......	......	......	165.2	237.5	284.7	163.5	206.7	134.5	53.2	50.0
	Per cent. of possible	......	......	......	......	36.4	52.0	53.8	38.1	55.3	39.3	18.1	17.6
1886	Hours	43.3	80.0	83.3	144.8	235.8	252.2	243.3	240.2	200.3	142.8	102.0	68.5
	Per cent. of possible	14.3	26.7	22.3	36.3	51.9	54.2	52.6	56.0	56.7	41.8	34.8	24.2
1887	Hours	44.0	61.5	110.7	159.0	265.0	217.8	267.5	235.8	......	......	......	......
	Per cent. of possible	14.5	18.2	29.7	39.9	58.4	47.6	57.9	55.0	......	......	......	......
1888	Hours	......	......	......	......	......	207.2	270.7	200.8	157.1	......	......	......
	Per cent. of possible	......	......	......	......	......	45.7	58.9	46.8	42.1	......	......	......
1889	Hours	65.8	84.6	124.4	164.7	185.2	158.6	255.3	234.2	152.0	106.8	65.4	62.3
	Per cent. of possible	22.4	28.6	33.6	41.0	40.8	34.7	55.2	54.6	40.7	31.3	22.3	22.0
1890	Hours	45.2	66.2	97.0	209.2	150.2	230.8	283.7	194.5	157.2	77.6	64.4	34.3
	Per cent. of possible	15.4	22.3	24.6	52.1	33.1	50.5	61.4	45.4	42.0	22.7	21.9	12.1
1891	Hours	77.8	96 8	155.8	150.7	139.7	220.6	240.2	223.7	220.5	187.6	83.2	104.6
	Per cent. of possible	26.5	32.7	42.1	33.4	30.8	48.6	52.0	52.1	59.0	54.9	28.4	37.0

READINGS OF THE

1891	JANUARY.			FEBRUARY.			MARCH.			APRIL.			MAY.			JUNE.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	35.7	38.5	38.5	37.0	40.0	37.0	8.0	14.0	10.0	35.0	44.2	44.5	47.0	46.5	39.8	64.5	83.5	80.0
2	40.5	43.8	29.3	20.6	21.0	22.5	5.4	15.5	16.5	39.0	46.0	38.0	43.7	62.5	53.4	64 7	61.4	63.6
3	13.0	13.0	10.5	39.0	37.7	21.0	17.4	26.0	27.0	32.5	36.0	36.0	48.0	50.4	53.0	60.0	65.2	51.0
4	9.5	14.7	13.0	9.1	12.0	8.5	29.0	29.8	21.0	27.0	26.5	27.5	45.0	48.0	41.2	43.6	51.5	51.0
5	16.7	19.0	15.2	10.0	27.2	28.8	16.0	20.5	19.5	25.0	32.2	31.0	32.0	37.0	36.0	49.0	61.0	58.0
6	15.2	15.0	13.0	29.0	40.0	37.0	14.0	26.0	22.0	28.0	36 0	34.5	34.0	43.0	44.0	49.1	63.0	61.2
7	22.2	21.2	18.0	29.0	31.2	32.0	21.0	28.2	28.0	26.8	35.0	35.0	42.0	47.0	47.6	52.0	66.0	67.1
8	13.4	22.3	19.8	29.0	26.0	25.0	26.0	38.4	38.0	28.4	38.0	36.0	47.5	65.0	68.0	50.0	73.0	74.0
9	20.8	24.4	23.0	27.0	32.3	36.0	39.0	39.0	33.6	30.5	45.4	47.0	64.7	77.2	74.0	58.0	78.0	78.0
10	16.0	25.0	25.0	30.4	30.0	26.4	25.5	31.2	35.0	35.5	39.0	41.0	62.5	82.0	77.8	65.5	85.5	84.0
11	34.2	35.0	33.0	16.0	32.0	26.2	34.8	47.5	44.5	42.0	50.5	46.0	49.5	48.2	51.8	73.5	83.2	75.8
12	28.0	25.6	22.2	24.0	35.0	35.0	38.0	40.5	40.3	41.0	44.0	41.0	49.2	63.0	58.8	60.5	72.0	70.3
13	15.4	16.7	16.5	20.0	29.2	25.0	35.0	42.8	33.0	42.8	56.5	60.3	48.0	67.0	61 0	60.7	78.0	76.3
14	28.6	34.0	26.5	13.4	14.8	10.0	22.2	24.5	20.5	50.9	68.0	55.0	48.5	57.0	55.4	65.4	87.6	83.8
15	18.0	28.0	34.0	16.0	33.4	36.0	16.0	25.0	33.0	53.2	58.0	52.2	44.5	69.5	69.0	74.0	91.2	89.3
16	12.0	10.3	6.3	45.2	45.8	39.4	35.0	26.0	20.0	44.2	49.0	50.0	52.0	42.0	42.2	81.0	89.7	75.8
17	24.5	30.3	24.4	34.0	31.0	28.0	10.0	21.5	29.4	39.0	60.0	66.2	39.5	48.0	49.0	65.6	73.7	72.0
18	18.0	20.5	19.8	37.2	32.0	27.0	33.4	50.0	34.0	55.8	67.0	66.0	54.8	55.0	56.2	62.0	64.1	61.1
19	22.7	26.6	26.0	23.8	26.0	27.0	19.0	24.5	25.0	55.5	59.8	56.0	40.8	63.0	68.8	59.0	65.0	66.0
20	31.4	34.3	32.4	26.4	31.0	35.5	33.3	33.0	34 0	46.0	59.5	54.0	58.2	73.0	71.5	65.1	70.1	74.0
21	34.5	38.9	38.0	38.5	43.5	37.0	32.5	40.0	36.0	41.2	62.4	66.0	61.6	71.4	71.1	68.5	72.8	70.0
22	35.0	35.4	34.9	28.5	28.0	23.5	34.5	41.0	38.0	57.8	66.0	71.4	59.1	52.0	52.2	66.4	79.0	72.0
23	31.0	35.4	32.8	19.5	30.5	36.0	37.5	44.0	43.6	61.0	63.0	58.0	43.0	56.0	55.0	67.5	76.8	68.5
24	33.0	37.2	32.6	36.2	46.0	43.5	37.0	45.0	37.8	38.0	46.2	47.2	49.4	62.5	61.0	63.2	71.5	75.2
25	29.5	30.0	27.6	47.4	56.8	43.0	27.0	32.5	28.5	39.2	45.0	45.8	55.4	72.0	69.9	70.8	82.5	82.8
26	30.0	36.0	33.0	28.4	27.0	25.0	23.0	33.0	32.3	42.0	56.5	57.0	45 0	42.1	51.0	76.0	82.2	69.5
27	24.6	34.0	37.8	17.4	21.0	17.0	31.0	38.0	37.4	61.2	75.8	71.2	47.0	57.7	58.5	56 0	63.5	66 0
28	32.5	37.0	33.0	20.3	29.0	21.0	32.0	46.8	42.0	47.0	46.5	39.8	49.0	70.0	63.6	58.0	70.5	71.0
29	35.5	38.7	40.5	.....	.....	.....	35.3	48.0	44.8	37.5	53 5	57.0	52.0	75.8	69.0	66.2	78.0	74.7
30	38.0	36.0	32.8	.....	.....	.....	33.4	48.0	41.0	57.6	76.5	73.5	60.8	68.6	69.0	66.0	80.8	81.8
31	29.2	34.5	36.0	.....	.....	.....	36.0	41.0	34.8	.....	.....	.....	62.0	77 0	73.5	....	....	....

STANDARD AIR THERMOMETER.

JULY.			AUGUST.			SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.		
7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
97.0	63.2	66.6	58.5	74.1	63.6	61.0	70.7	62.2	46.0	65.8	63.3	41.8	43.0	36.2	19.2	38.0	33.4
63.1	70.0	70.5	59.0	69.0	64.2	59.2	71.0	66.1	55.2	76.4	74.0	28.0	35.5	36.0	37.0	48.0	43.4
64.0	70.3	68.5	58.7	73.8	68.1	58.0	73.2	73.0	62.2	86.0	77.0	30.0	33.0	27.8	41.3	47.2	46.0
56.6	66.5	65.0	61.8	69.5	66.0	64.0	78.0	59.6	65.0	82.6	76.0	29.4	36.2	35.7	52.3	57.2	37.6
58.1	59.4	60.8	64.0	71.0	72.0	60.8	62.7	58.0	58.0	57.0	52.5	33.0	39.0	36.0	40.5	49.5	45.0
58.6	71.8	65.7	63.8	77.0	77.5	64.5	64.0	65.0	46.8	53.9	44.7	30.0	41.0	34.4	32.7	37.0	35.1
55.7	56.2	57.8	65.0	86.0	71.2	58.5	68.0	63.0	43.0	46.8	49.5	25.8	47.7	43.2	40.6	31.5	29.5
54.6	61.4	60.1	70.0	80.8	79.2	50.4	60.2	54.0	49.5	52.7	47.6	38.0	58.2	54.2	27.5	35.7	36.4
58.5	70.6	69.5	69.5	78.3	75.1	51.5	64.0	60.8	38.5	58.7	50.8	47.2	60.8	57.0	40.0	47.6	40.0
60.0	77.1	75.0	69.0	84.0	81.0	52.0	70.1	68.0	42.1	61.5	54.4	47.0	56.0	57.5	33.5	51.2	46.5
65.0	79.9	79.8	73.0	89.5	80.0	54.2	73.7	68.0	45.5	41.8	37.5	49.3	55.2	48.0	38.5	42.3	37.0
66.0	85.2	80.0	70.6	69.8	70.0	57.7	73.5	70.0	30.6	47.0	42.0	45.5	43.2	42.5	37.0	46.0	44.0
69.0	88.0	87.0	62.2	74.1	70.4	62.6	73.0	67.6	32.8	57.0	50.0	34.8	44.7	41.5	43.6	50.6	46.5
74.0	88.4	78.1	63.0	76.7	73.6	54.0	59.9	58.0	38.5	60.4	56.9	34.0	34.5	33.0	45.0	43.1	32.0
72.0	78.8	75.0	63.0	68.7	70.0	51.8	57.8	64.0	48.0	54.1	47.0	30.8	41.5	40.0	33.8	42.0	44.4
63.5	72.0	69.7	59.2	78.8	70.0	55.8	60.4	61.0	44.6	45.9	46.0	45.8	53.5	52.8	33.0	33.0	25.2
64.7	80.5	80.9	63.0	82.4	77.0	58.7	86.5	80.9	36.0	54.4	51.0	57.8	39.0	30.4	10.0	9.2	12.0
67.2	66.0	64.8	67.5	79.0	73.0	76.0	88.0	82.2	46.0	59.3	52.0	21.2	27.2	22.3	15.0	20.0	18.1
63.1	69.4	72.5	64.5	78.0	73.9	61.5	70.0	60.3	43.6	57.3	55.0	22.0	35.5	33.0	20.2	34.0	30.0
61.5	75.0	67.2	66.0	82.2	79.4	53.0	77.1	70.3	46.0	46.0	45.8	34.0	38.5	40.0	27.0	36.3	34.4
61.0	74.0	71.0	72.0	75.6	72.0	64.3	88.5	74.4	46.9	51.1	47.5	41.0	52.4	48.6	28.0	41.2	36.6
64.0	84.0	83.0	64.5	78.8	77.5	62.7	81.0	74.0	38.0	39.0	35.7	48.6	53.7	55.0	40.0	43.0	47.0
73.0	79.8	74.5	63.0	65.2	62.0	63.5	80.8	72.0	33.0	42.0	44.4	53.0	58.1	45.6	42.8	43.2	44.0
68.2	79.4	74.2	63.5	73.0	73.0	64.2	87.3	79.6	38.6	46.0	37.8	40.8	38.5	35.4	37.2	37.6	39.2
61.7	70.2	64.8	61.4	68.0	66.5	66.4	89.0	81.6	28,5	46.0	44.4	31.0	35.0	27.5	43.2	45.2	45.5
57.0	66.5	62.0	59.0	72.4	72.0	62.4	78.6	66.0	49.8	60.0	55.0	24.6	37.0	35.0	47.2	50.0	33.5
66.7	67.8	69.0	66.8	79.0	77.0	58.7	82.2	75.0	35.0	34.2	34.0	33.5	36.5	31.3	24.0	28.0	25.7
60.8	78.0	69.2	67.0	69.0	61.2	68.0	85.2	75.8	31.0	38.4	35.0	27.0	23.0	17.0	21.0	32.0	33.0
60.5	75.7	76.9	53.0	65.5	62.0	70.0	72.7	59.0	32.0	54.0	49.6	14.6	12.0	13.9	34.0	38.0	38.8
63.4	64.0	68.4	54.0	70.0	65.0	47.5	58.0	51.0	43.7	54.4	63.8	16.0	25.4	27.2	31.0	30.0	27.6
55.0	65.0	64.0	61.0	70.0	62.1	.....	.....	.....	49.0	60.4	51.1	.....	.....	.....	15.0	23.5	26.0

READING OF MAXIMUM AND MINIMUM THERMOMETERS AT 7 A. M.

1891.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER		OCTOBER.		NOVEMBER.		DECEMB'R.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1	35.7	14.0	38.2	28.5	30.0	6.5	41.0	33.0	65.5	35.5	81.0	55.0	84.8	61.5	70.0	51.0	70.0	58.0	62.8	39.5	68.0	40.5	30.6	15.0
2	41.5	35.0	41.0	19.0	16.0	4.5	45.5	35.0	82.5	38.0	85.2	60.0	71.0	61.5	77.0	55.5	76.0	60.5	71.6	45.0	39.9	27.0	44.7	18.2
3	46.0	12.5	39.8	18.0	17.0	5.0	48.0	31.5	50.6	35.0	69.6	56.5	74.0	58.0	69.4	49.0	78.0	62.0	85.0	54.5	41.0	27.4	50.4	35.5
4	17.2	8.5	42.5	8.5	28.0	17.0	42.8	26.0	54.0	29.5	71.0	41.5	77.0	56.0	77.0	58.5	71.0	58.0	89.4	61.5	35.2	26.5	52.8	40.0
5	17.0	8.5	12.6	6.0	30.0	16.0	28.0	23.0	43.0	30.0	58.0	37.0	71.0	56.0	71.4	61.0	74.0	54.0	86.0	57.0	39.2	28.5	57.7	34.5
6	22.5	14.0	34.0	7.0	27.0	13.0	40.0	24.0	40.0	30.0	62.0	40.0	63.0	51.0	73.0	57.0	73.6	58.4	62.0	45.5	39.6	29.0	53.0	32.0
7	19.2	11.5	43.8	27.5	29.5	14.0	43.0	21.0	42.0	33.5	64.5	46.0	72.0	54.0	81.5	56.5	75.5	53.5	56.5	41.5	44.6	25.0	45.0	30.0
8	25.0	12.5	35.0	28.0	32.0	20.0	39.5	26.0	53.0	41.0	69.6	44.0	58.0	50.0	88.5	64.0	71.0	47.5	50.0	42.0	52.2	25.0	42.0	26.0
9	25.5	12.0	30.0	23.0	41.0	26.0	43.0	26.0	71.3	46.5	77.0	48.0	63.0	51.5	84.0	68.0	63.0	43.5	53.4	36.5	60.2	36.7	41.4	26.5
10	27.0	12.0	38.8	26.6	43.5	24.5	49.8	31.0	80.5	46.5	84.0	54.5	73.0	50.0	81.4	65.0	68.0	47.0	61.6	38.0	65.2	45.5	50.2	30.5
11	34.2	14.0	33.0	14.7	40.8	24.5	43.0	34.0	85.5	48.5	89.0	65.0	79.0	55.0	88.0	67.0	72.5	49.0	65.0	41.0	63.3	44.0	57.0	32.5
12	31.5	22.0	35.5	13.5	57.0	35.0	54.0	39.4	50.5	41.0	87.5	58.0	83.0	58.0	92.0	67.0	75.0	52.5	47.6	27.0	58.1	42.0	44.7	32.0
13	34.0	14.5	31.0	11.0	44.3	34.0	45.6	40.0	64.8	37.0	74.5	49.5	83.0	60.5	75.2	57.0	78.5	57.0	50.1	31.0	48.5	32.5	49.0	36.5
14	28.6	12.4	30.4	12.5	54.2	22.0	61.0	42.0	70.5	43.0	83.0	52.0	92.0	63.0	78.0	55.0	78.0	51.5	59.4	32.0	46.0	33.0	52.2	42.4
15	35.2	17.5	16.4	2.5	30.0	15.0	72.0	49.0	59.5	36.0	91.4	61.5	90.2	66.5	79.8	58.0	62.5	50.0	62.8	38.0	37.5	29.8	46.0	29.0
16	35.0	11.0	45.2	11.5	39.8	15.5	49.5	42.0	74.8	44.0	95.0	64.0	79.8	59.5	79.7	54.0	64.8	50.5	62.7	38.0	49.5	25.7	49.0	32.5
17	24.5	4.0	48.0	33.5	40.8	8.0	50.5	35.0	53.0	31.5	91.5	64.5	79.8	53.5	81.2	56.0	65.9	52.5	48.8	34.5	58.1	39.0	38.5	8.5
18	31.4	17.0	48.2	24.5	35.0	10.0	69.0	39.4	54.8	38.0	78.0	56.5	83.0	63.0	83.0	63.0	91.0	57.5	60.2	35.4	57.7	19.5	15.2	7.0
19	22.7	15.5	41.8	22.0	53.5	18.8	71.0	54.0	58.8	34.5	64.3	57.5	71.4	59.0	79.2	60.0	90.7	60.0	59.8	40.0	29.6	20.0	28.0	14.0
20	31.4	21.5	30.0	23.0	36.0	18.0	61.0	40.5	71.0	40.0	67.0	58.0	76.0	52.0	80.8	58.5	70.1	45.0	60.3	43.0	40.0	21.0	38.0	19.0
21	38.0	28.0	39.5	25.5	37.0	32.5	61.0	34.5	79.4	61.5	76.5	64.0	80.6	52.7	87.0	65.0	83.4	45.0	47.0	43.0	42.0	33.0	40.0	25.3
22	40.0	33.0	43.5	27.2	41.0	32.0	69.8	41.0	75.1	58.2	77.0	65.0	76.5	54.4	78.8	60.0	93.0	60.0	54.4	37.0	53.9	40.0	44.0	26.0
23	36.8	29.5	42.7	18.0	45.0	34.5	79.0	57.0	58.0	36.5	83.4	65.0	87.0	63.0	81.5	62.0	83.4	60.5	40.9	32.0	57.1	47.5	48.3	39.5
24	38.5	29.5	37.0	18.5	47.5	37.0	64.0	37.0	59.0	37.0	79.0	55.0	82.6	65.0	67.0	60.0	84.0	60.0	47.0	32.4	65.4	35.5	44.0	34.0
25	38.8	28.5	50.0	36.0	50.0	26.5	50.0	36.0	63.0	46.0	76.8	62.4	82.0	50.0	77.2	54.0	90.0	63.5	42.4	27.0	41.9	29.0	43.7	36.0
26	31.4	23.5	56.8	27.5	36.0	21.5	48.8	35.5	70.6	44.0	87.0	69.4	68.0	57.0	77.2	53.0	92.8	60.5	50.5	28.0	40.0	23.2	51.0	42.2
27	37.8	24.0	30.0	20.0	30.3	22.5	62.0	41.5	51.3	36.3	83.0	50.0	69.5	49.5	80.0	64.0	81.0	53.0	61.3	34.0	41.0	23.0	54.2	23.0
28	40.3	23.5	21.0	14.0	44.5	29.0	81.4	45.0	63.0	36.0	68.0	50.5	73.0	51.0	81.0	63.0	85.0	58.0	38.2	29.7	41.3	26.5	29.3	19.0
29	37.0	31.5	......	......	49.0	32.0	51.5	32.0	74.7	42.0	73.0	51.5	80.0	55.5	71.4	46.5	86.8	65.0	42.4	29.0	29.0	12.0	35.0	19.7
30	42.0	34.0	......	......	52.0	29.5	60.5	36.5	79.0	51.0	80.5	54.0	80.0	59.5	69.0	48.5	86.5	43.0	60.3	31.5	17.5	12.5	41.0	30.5
31	38.8	28.0	......	......	52.4	30.0	......	......	73.6	51.0	....	....	69.8	46.0	71.8	53.5	......	......	67.8	42.8	......	......	34.0	13.5
Aver..	32.4	19.4	37.0	19.5	39.7	21.8	54.2	36.3	63.6	40.3	77.6	55.2	76.5	56.2	78.5	58.4	77.8	54.5	58.3	38.3	46.7	30.0	43.5	27.4

READING OF SOIL THERMOMETERS.

1891.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES,			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
April 1	33.0	51.0	40.0	34.6	45.2	40.8	35.0	44.2	41.0	35.0	43.0	41.2	36.5	38.8	41.0	37.0	37.2	39.0	43.5	43.5	43.5
2	38.0	49.0	38.5	37.6	45.5	39.5	37.8	45.0	40.2	37.8	44.2	40.5	38.7	40.7	41.3	38.4	37.8	40.0	43.7	43.8	43.5
3	36.0	42.0	38.0	34.6	39.3	38.0	35.0	39.0	38.2	35.0	38.5	38.2	37.0	37.4	38.6	37.4	37.2	38.0	44.0	44.0	43.5
4	32.0	32.0	30.0	33.5	33.0	32.5	34.0	33.5	33.0	34.2	34.0	33.5	36.6	36.0	35.6	37.0	36.5	36.0	43.5	43.4	43.0
5	30.0	43.0	32.0	30.0	32.5	35.0	31.3	32.7	35.0	32.0	32.7	35.0	34.6	34.5	35.8	35.3	35.0	35.0	42.5	42.4	42.0
6	34.0	42.0	34.0	32.0	42.5	40.2	32.5	40.0	39.5	33.0	36.7	40.6	34.5	34.8	40.0	35.0	34.8	37.0	42.0	42.0	42.0
7	32.0	50.0	35.0	33.0	37.6	38.5	33.5	35.7	39.0	34.0	34.5	39.3	35.5	35.5	38.7	36.0	35.5	37.0	42.4	42.3	42.0
8	31.0	49.0	36.0	32.5	44.0	41.5	32.5	42.5	42.0	33.2	40.5	42.0	35.4	35.8	40.5	35.8	35.5	38.0	42.4	42.4	42.4
9	30.5	45.4	47.0	34.0	68.0	44.0	34.5	49.2	45.5	33.0	47.2	45.9	33.5	45.5	45.5	35.7	37.0	43.0	36.3	36.2	39.8
10	36.0	38.2	40.0	38.0	38.0	39.5	38.5	38.0	39.5	39.0	38.0	39.5	39.7	38.8	39.2	39.0	38.5	38.5	43.4	44.0	43.7
11	42.0	50.0	46.4	40.0	44.5	46.5	39.8	43.5	46.4	39.8	42.8	46.0	39.5	40.7	43.0	38.7	39.0	40.7	43.8	44.0	44.0
12	40.8	44.0	41.8	40.0	42.5	41.0	40.0	42.5	41.2	40.2	42.5	42.2	40.8	41.5	41.0	40.4	40.4	40.8	44.6	44.8	45.0
13	45.0	68.0	53.5	40.5	54.5	53.5	40.5	51.5	53.2	40.6	49.0	52.5	41.0	43.5	58.0	40.4	41.0	44.0	45.0	45.2	45.5
14	49.9	69.0	55.0	45.0	68.0	55.0	44.7	55.8	55.0	44.8	53.5	54.7	44.7	47.4	51.2	43.8	44.2	47.0	46.8	47.0	47.4
15	54.0	60.0	51.0	51.6	57.0	51.7	50.5	56.0	52.0	50.0	54.7	52.0	48.7	50.0	50.5	47.0	47.0	48.2	48.7	49.0	49.2
16	48.0	52.2	51.0	46.0	49.5	50.2	46.0	49.0	50.0	46.0	48.7	50.0	46.8	47.4	48.4	46.3	46.0	46.5	49.7	50.0	49.5
17	44.0	70.8	58.2	41.0	56.0	58.0	41.0	53.5	57.5	41.2	51.5	56.8	43.8	56.5	51.7	44.5	44.6	47.7	49.5	49.4	49.5
18	54.0	70.0	62.0	51.3	58.4	59.4	51.0	56.7	58.6	50.6	55.2	57.9	49.4	50.8	53.6	47.8	48.2	50.0	50.3	50.5	50.8
19	55.0	62.0	56.0	53.7	59.2	56.0	53.7	58.3	56.2	53.7	57.2	56.0	52.5	53.5	54.0	50.3	50.5	51.4	51.8	52.0	52.2
20	50.8	67.0	50.0	45.9	62.0	60.0	45.9	59.4	60.3	46.0	57.0	60.0	48.4	51.4	56.5	48.8	48.0	52.2	52.6	52.5	52.5
21	47.0	74.0	61.0	43.0	57.4	60.8	42.5	55.5	60.2	43.3	53.7	59.2	47.0	49.7	54.8	48.3	48.0	51.0	53.0	52.8	52.8
22	55.2	67.0	67.0	51.6	60.4	64.8	51.0	59.0	64.2	50.5	57.5	63.0	50.7	53.4	57.7	50.0	50.6	53.0	53.3	53.4	53.5
23	58.0	71.5	53.0	56.0	62.6	57.4	56.0	62.2	57.8	55.8	59.7	58.0	54.5	56.0	56.8	52.8	53.0	54.0	54.5	54.6	54.8
24	42.0	56.0	48.0	42.5	52.5	53.2	42.2	51.2	53.5	43.8	50.0	53.5	47.0	48.0	51.4	48.2	47.8	49.4	54.2	53.8	53.4
25	56.5	77.0	49.8	45.2	56.7	56.7	46.0	55.0	57.2	47.0	53.6	57.0	49.8	51.0	55.2	50.5	50.0	52.3	55.0	54.6	54.5
26	46.0	81.5	57.5	41.5	58.0	59.4	41.4	55.5	59.4	41.8	53.4	58.9	45.0	48.5	54.5	46.4	47.0	50.5	55.0	53.0	52.7
27	58.0	91.0	69.0	51.0	65.8	68.6	50.2	63.0	68.4	49.8	60.8	67.2	49.5	53.5	60.3	49.0	50.0	54.4	53.5	53.5	53.7
28	49.2	57.3	44.0	49.5	55.5	49.0	50.2	54.5	50.0	50.7	53.8	50.8	52.5	52.2	52.0	52.3	51.2	51.4	55.0	55.0	54.7
29	46.0	77.0	57.0	40.2	55.7	58.5	40.3	53.7	58.5	41.0	52.2	58.0	45.0	48.2	54.0	47.0	47.0	50.5	54.0	53.5	53.2
30	60.0	90.0	72.0	49.5	66.0	68.2	48.8	63.4	67.5	48.5	61.0	66.5	49.0	53.5	59.7	49.0	50.0	54.0	53.8	53.6	54.0

READING OF SOIL THERMOMETERS—(*Continued*).

1891.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M	12 M.	6 P.M.	7A M.	12 M.	6 P M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
May 1	52.0	61.0	46.0	45.5	69.5	55.4	52.0	60.0	64.0	52.5	58.8	63.8	54.0	54.7	59.5	53.4	52.5	55.0	55.3	54.5	55.5
2	50.0	68.0	53.4	49.5	56.6	54.5	46.0	68.0	54.6	46.5	56.6	55.6	50.0	52.5	54.5	51.0	50.7	52.4	55.7	55.5	55.2
3	49.0	60.0	48.8	42.0	51.0	48 8	49.8	55.2	55.0	50.0	54.0	55.0	51.0	51.5	54.0	50.6	50.5	51.6	55.0	55.0	55.0
4	42.5	60.6	43.5	37.0	43.0	42.0	46.0	49.7	48.9	43.2	49.0	50.5	46.7	48.2	51.0	48.2	48.0	49.5	54.6	54.3	54.0
5	35.0	43.5	40.0	51.4	62.0	63.5	38.0	42.5	42.7	38.8	42.5	43.2	43.0	43.8	43.7	45.4	45.0	45.2	53.3	52.9	53.2
6	37.2	50.0	44.0	37.5	46.5	46.0	38.0	45.7	46.4	38.6	45.0	46.6	41.5	43 5	46.0	43.0	43.4	45.0	51.5	51.2	51.0
7	46.0	59.0	49.0	42.0	51.7	50.6	42.0	50.2	52.0	42.0	49.0	52.0	43.6	46.0	49.5	44.4	45.0	47.0	51.0	51.0	51.0
8	48.7	66.0	63.0	45.3	55.3	58.4	45.3	54.0	57.6	45.2	52.5	56.6	46.0	48.5	52.0	46.0	46.6	49.0	51.5	51.6	51.8
9	65.0	94.0	70.0	54.0	69.0	70.0	52.7	66.5	69.8	52.0	64.2	69.0	50.8	55.2	61.6	49.4	50.7	55.2	52.7	53.0	53.7
10	64.0	100.0	75.0	53.4	72.0	73.5	52.4	70.0	73.3	52.2	67.8	72.2	53.0	58.5	64.5	52.4	53.5	67.8	55.0	55.2	55.7
11	53.0	56.0	57.0	54.5	55.0	57.4	55.0	55.2	57.7	55.4	55.2	58.0	56.4	55.0	56.4	55.4	54.0	54.2	57.0	56.8	56.7
12	59.4	90.0	61.6	48.2	66.7	65.5	47.5	64.2	65.8	47.5	62.0	65.7	50.0	54.5	60.5	50 8	51 5	55.5	56.2	56.0	56.0
13	57.0	93.4	65.0	47.5	68.0	67.8	47.4	65.7	68.0	47.8	63.7	67.0	50.6	55.4	62.2	51.6	52.2	56.6	56.5	56.4	56.4
14	53.0	78.0	60.0	50.0	62.5	62.6	42.0	58.4	57.7	50.5	59.3	63.0	53.3	55.0	59.4	53.5	53.2	56.2	57.3	57.2	57.0
15	51.3	83.0	69.0	46.5	64.6	65.0	50.5	60.7	63.0	47,0	60.5	64.4	50.5	53.2	59.7	52.0	52.0	55.5	57.2	57.0	56.8
16	52.0	49.4	46.0	53.0	50.7	49.4	46.5	62.5	65.0	53.6	52.2	50.7	54.5	53.6	52.2	54.0	53.6	52.2	57.4	57.2	57.0
17	52.2	80.0	53.0	42.5	59.8	57.0	53.4	51.5	50.0	42.8	56.5	58.0	46.6	50.8	55.6	47.6	49.0	52.5	56.0	55.5	55.5
18	54.0	58.0	57.0	51.2	54.7	56.1	51.3	54.5	56.0	51.2	54.0	55.7	51.5	52.4	53.5	51.0	51.2	51.6	55.8	55.7	55.7
19	46.0	77.8	65.0	44.4	59.5	62.7	44.6	57.5	62.5	45.0	55.6	62.0	48.0	50.5	57.0	49.0	49.0	52.7	55.4	55.1	55.0
20	58.5	76.0	71.0	55.0	68.0	67.6	54.8	66.0	67.6	54.7	64.6	67.0	53.8	57.2	61.7	52.5	53.5	56.8	56.0	56.2	56.5
21	63.5	74.0	71.0	59.6	64.2	66.6	59.5	63.2	66.0	59.3	62.3	65.5	58.0	59.0	61.2	56.2	56.2	57.5	57.8	58.0	58.2
22	60.3	57.2	56.5	60.4	57.6	56.5	60.4	58.0	56.7	60.2	58.1	56.8	59.0	57.9	56.7	57.0	56.5	55.7	58.7	58.7	58.7
23	55.5	83.2	60.5	46.3	66.0	65.2	46.0	64.0	65.6	47.0	61.1	65.7	50.4	54.5	61.0	52.0	52.4	56.4	58.2	57.7	57.7
24	55.5	77.0	65.4	49.9	62.6	62.2	49.6	61.0	62.1	49.8	59.3	61.9	51.8	54.6	58.9	52.8	53.0	55.3	58.0	58.0	57.9
25	64.6	94.0	73.0	52.4	73.4	70.7	52.0	70.4	70.6	52.0	67.3	70.0	53.0	58.0	64.4	53.4	54.3	58.8	58.0	58.0	58.2
26	51.4	49.3	53.0	54.0	51.6	55.2	55.0	52.5	55.5	55.6	53.2	55.4	57.6	55.3	55.0	56.8	55.4	54.3	59.3	59.2	59.0
27	57.0	73.0	62.0	46.0	66.6	65.4	45.4	63.8	65.5	46.0	61.1	65.2	49.0	54.0	60.0	51.0	51.5	55.7	58.0	57.6	57.5
28	57.0	85.0	65.5	48.4	69.2	67.4	48.2	66.4	67.5	48.7	63.5	67.2	51.1	56.0	62.2	52.4	53.0	57.3	58.0	58.0	58.0
29	56.0	97.0	71.3	54.0	53.8	70.0	54.2	70.2	70.1	54.2	67.2	69.8	55.2	58.0	64.3	55.0	55.2	59.1	58.9	59.0	59.0
30	62.6	75.0	69.0	59.9	70.2	69.2	59.5	68.6	69.0	59.6	67.4	68.8	59.2	61.7	64.8	58.0	58.4	60.7	60.0	60.3	60.5
31	68.0	88.0	74.6	58.5	78.0	75.2	58.0	75.0	76.0	58.0	72.0	75.0	58.6	63.4	69.0	58.4	59.2	63.2	61.3	61.4	61.6

READING OF SOIL THERMOMETERS — (*Continued*).

1891.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
June 1	71.2	99.0	79.0	61.2	80.2	78.0	60.7	77.6	77.8	60.8	74.9	77.1	61.0	65.4	70.5	60.4	61.1	64.8	62.5	62.7	63.0
2	69.4	67.0	68.0	63.8	65.5	67.7	63.5	65.5	67.6	63.6	65.5	67.5	63.7	64.4	65.2	62.4	62.2	62.5	64.0	63.8	63.7
3	63.0	75.0	59.0	61.5	68.7	62.2	61.4	67.5	63.2	61.3	66.6	63.9	61.2	62.4	64.3	60.5	60.6	62.2	63.5	63.5	63.4
4	50.0	64.0	55.2	51.0	57.3	60.1	51.6	56.2	61.3	62.5	65.6	62.1	55.7	56.0	60.7	57.4	56.5	58.4	63.0	62.7	62.0
5	56.6	75.2	64.2	49.0	68.0	65.0	46.0	66.0	65.4	49.8	64.0	62.4	52.8	57.7	59.3	54.9	55.5	59.4	63.0	61.4	61.2
6	54.0	76.0	63.5	51.3	65.5	64.0	51.4	63.2	64.1	52.0	61.6	64.0	54.3	57.0	61.5	55.6	56.7	58.5	61.6	61.4	61.2
7	58.0	83.5	67.1	53.9	69.5	70.0	54.0	67.4	70.2	54.1	64.7	70.3	55.5	58.5	65.4	56.0	56.5	60.5	61.4	61.4	61.5
8	56.0	87.0	71.4	52.2	72.7	72.2	52.6	70.2	72.4	53.2	67.6	72.2	56.2	60.0	65.6	57.2	57.4	65.1	62.0	62.0	62.0
9	68.0	94.5	76.0	56.4	77.7	76.7	56.4	75.8	77.2	56.5	72.6	77.0	58.3	64.1	70.1	58.6	69.1	64.0	62.6	62.8	63.0
10	75.0	104.0	82.0	61.5	84.2	81.5	61.0	81.6	81.6	61.2	78.1	81.2	61.7	66.0	73.5	61.4	62.2	67.0	64.0	64.0	64.4
11	80.8	92.0	77.0	68.5	78.5	76.7	68.3	77.8	76.0	68.0	75.8	77.0	66.0	69.8	72.5	65.2	65.7	68.0	65.7	65.7	66.0
12	66.0	96.0	75.0	62.6	82.4	77.8	63.2	80.1	78.5	63.6	77.5	78.8	65.0	68.5	73.6	64.7	68.4	66.7	66.6	66.7	66.7
13	76.0	99.4	78.0	60.5	83.0	80.0	60.6	81.0	80.5	61.2	77.9	80.6	63.1	68.0	74.3	63.9	64.0	68.3	67.0	67.8	66.9
14	75.0	107.0	84.5	62.5	86.4	83.5	62.4	84.0	83.7	62.7	80.6	83.6	64.2	69.5	76.5	64.4	65.0	70.0	67.3	67.3	67.3
15	84.0	107.0	89.0	68.0	89.0	86.7	67.5	86.6	87.0	67.5	83.5	86.7	67.8	72.5	79.3	67.0	67.8	72.4	68.5	68.5	68.7
16	90.0	102.0	74.0	71.6	88.0	74.5	70.8	87.2	74.7	70.6	83.4	74.8	70.0	74.5	73.5	69.0	69.8	71.6	69.8	69.7	71.0
17	70.0	81.0	73.0	68.5	75.5	76.0	68.6	74.5	76.2	68.8	73.5	76.0	69.0	70.2	73.0	68.2	68.0	69.5	70.4	70.3	70.2
18	65.4	67.2	63.5	64.7	66.3	64.0	65.0	66.4	64.7	65.3	66.3	65.0	66.6	66.5	66.0	69.9	66.0	65.6	70.2	70.0	69.5
19	61.0	70.5	67.5	60.5	66.7	66.5	61.0	66.0	66.5	61.4	65.5	65.5	62.8	63.8	64.0	63.2	63.0	64.0	68.5	68.2	67.9
20	68.0	74.0	74.0	63.7	69.0	72.7	63.4	68.2	72.5	63.3	67.6	72.4	63.5	65.5	68.7	63.2	63.6	65.5	67.8	67.5	67.7
21	69.0	76.0	71.0	66.5	72.2	70.5	67.2	71.2	70.5	66.0	70.4	70.7	65.7	66.8	68.8	65.0	65.0	66.1	68.0	68.1	68.1
22	69.0	87.0	76.0	67.2	79.5	75.0	67.1	77.8	75.0	67.2	75.5	74.8	66.8	69.0	72.6	65.6	66.0	69.0	68.6	68.8	68.9
23	73.0	82.0	69.0	66.4	77.4	71.8	66.5	76.8	73.0	67.0	75.2	73.8	67.5	69.8	72.2	67.0	67.2	69.2	69.9	69.8	69.9
24	69.3	82.0	72.0	61.0	76.0	74.5	61.2	75.2	74.6	62.0	73.2	74.8	64.0	67.5	71.5	65.2	65.5	68.2	70.0	69.8	69.8
25	72.5	91.0	82.6	64.4	83.5	81.5	64.5	81.0	81.7	64.3	78.0	81.0	65.6	70.0	75.3	66.0	66.5	70.5	70.0	69.7	70.0
26	78.0	97.0	74.0	69.5	86.5	79.0	68.8	84.3	80.2	68.7	81.2	80.5	68.9	72.7	75.5	68.4	69.1	72.2	71.2	71.3	71.4
27	68.0	83.5	69.4	60.5	78.0	75.0	61.0	77.0	76.0	62.0	74.4	76.3	65.4	68.3	73.0	68.0	66.6	69.4	71.6	71.3	71.0
28	65.4	89.2	72.0	58.6	79.8	76.0	59.5	77.2	76.6	60.0	74.0	76.8	63.5	67.5	72.5	65.2	65.5	68.8	71.0	70.5	70.4
29	73.0	93.3	76.0	61.0	82.0	79.0	61.0	80.1	79.6	61.3	77.0	79.6	63.6	68.4	74.6	65.0	65.5	69.8	70.5	70.2	70.1
30	74.2	98.5	83.0	63.5	83.5	81.7	63.5	82.0	82.0	63.8	78.5	81.8	65.6	70.0	76.0	66.5	67.0	70.9	70.7	70.7	70.7

READING OF SOIL THERMOMETERS — (*Continued*).

1891.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A M.	12 M.	6 P.M.	7 A.M	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
July 1	70.0	67.0	70.0	67.6	68.4	68.2	67.5	68.8	68.4	67.6	68.2	68.4	63.6	68.4	74.6	65.0	65.5	69.8	71.4	71.2	71.0
2	66.0	78.7	71.3	64.5	71.0	71.1	64.6	70.0	71.2	64.8	68.9	71.1	65.6	70.0	76.0	68.0	67.7	67.2	70.4	70.2	70.0
3	66.0	76.0	66.0	62.5	67.4	67.5	62.7	67.5	68.0	63.0	65.8	68.4	68.0	68.5	68.0	65.5	65.5	67.1	70.0	69.8	69.8
4	58.0	72.0	63.4	59.1	64.2	64.6	59.7	64.0	65.2	60.3	63.8	65.8	65.5	66.6	69.4	64.8	64.7	65.8	69.2	69.0	68.7
5	62.0	64.0	61.4	58.4	60.5	61.0	58.6	61.0	61.3	59.0	61.3	61.6	64.3	65.0	67.6	63.1	63.0	64.4	68.2	68.0	67.7
6	64.0	78.8	64.0	55.5	71.2	65.4	56.0	70.0	65.8	56.3	68.8	66.1	58.8	63.1	65.4	60.2	61.0	63.4	67.2	67.0	66.9
7	58.7	63.0	60.0	58.0	59.4	59.5	58.3	59.5	59.6	58.7	59.8	59.8	60.4	60.5	60.4	61.0	60.7	60.4	67.0	66.9	66.5
8	63.0	77.0	64.5	55.0	68.0	65.5	55.5	67.0	66.1	56.0	65.8	66.8	58.2	61.4	65.0	59.2	59.8	62.5	66.0	66.0	65.9
9	63.0	82.0	66.0	57.5	73.3	69.0	58.5	72.6	69.6	58.6	71.0	70.1	59.8	74.3	67.9	60.5	61.5	64.7	66.4	66.4	66.5
10	65.0	88.0	71.8	57.5	75.5	74.0	58.0	74.6	74.4	58.2	72.5	74.4	60.6	65.2	70.0	61.8	62.5	66.0	67.4	67.2	67.3
11	68.7	87.0	75.3	61.0	77.5	76.8	60.7	76.0	77.1	61.0	73.6	77.0	62.7	66.4	71.8	63.4	63.4	67.4	68.0	68.0	68.2
12	68.0	98.0	80.0	62.5	81.0	79.5	63.0	80.3	80.1	63.0	77.4	80.0	64.5	69.2	74.4	65.0	65.8	69.3	69.0	69.0	69.1
13	73.3	99.0	83.0	66.4	82.0	81.7	66.5	81.0	82.0	66.3	78.7	81.7	67.2	70.9	76.0	67.0	67.6	71.0	70.1	70.2	70.4
14	77.8	99.5	81.0	68.5	82.1	80.0	68.4	81.2	80.5	68.0	79.3	80.8	68.6	72.0	76.7	68.3	68.9	72.1	71.2	71.2	71.4
15	72.0	84.0	73.3	68.4	75.0	73.0	68.5	75.3	73.7	68.7	74.8	74.0	69.2	71.1	72.5	68.9	69.0	70.4	71.9	71.9	71.8
16	70.0	84.0	70.0	63.8	75.5	72.0	64.4	75.0	73.0	64.7	74.0	73.7	66.5	69.0	72.5	67.0	67.2	70.0	71.6	71.2	71.7
17	68.0	95.5	80.0	61.4	78.4	78.2	61.6	78.0	78.6	62.0	75.6	78.7	64.6	68.7	74.0	66.0	66.4	69.9	71.3	71.0	71.0
18	69.0	70.6	67.0	67.1	68.8	66.5	67.2	69.0	67.0	67.3	68.8	66.9	67.7	68.3	67.2	67.4	67.1	66.8	71.3	71.0	71.0
19	69.0	76.0	70.0	62.5	71.0	71.0	63.0	70.5	70.7	63.4	69.5	71.8	64.8	67.0	69.8	65.2	65.4	67.2	70.4	70.2	70.0
20	65.2	88.0	69.9	60.0	75.5	70.5	60.4	73.8	70.9	61.0	71.8	71.4	63.4	66.7	70.0	64.5	64.8	67.4	70.1	70.0	69.9
21	66.0	88.0	72.0	60.0	74.4	72.2	60.4	73.4	73.8	61.0	72.0	73.7	63.6	67.0	71.0	64.7	65.2	68.0	70.2	70.0	70.0
22	68.0	96.4	78.5	61.4	76.0	76.6	61.6	74.5	76.7	62.0	72.7	76.8	63.8	67.3	72.3	65.0	65.3	68.6	70.3	70.3	71.2
23	73.0	94.0	74.0	69.0	74.5	71.6	68.7	73.5	69.8	68.8	72.5	70.8	68.4	69.5	69.2	67.7	67.5	67.1	71.0	70.7	71.0
24	70.5	88.0	76.0	67.8	76.0	74.8	67.9	74.6	75.0	68.0	73.6	75.1	68.4	69.5	72.4	67.9	67.8	69.7	71.2	71.4	71.3
25	66.0	83.0	68.6	64.2	72.4	70.4	64.7	71.5	70.8	65.0	70.7	71.5	66.7	68.4	70.5	67.0	67.1	68.6	71.4	71.4	71.2
26	61.5	67.0	64.3	58.0	66.0	66.4	58.4	65.4	66.5	59.3	64.9	67.1	62.7	64.0	66.1	64.5	64.1	65.0	71.0	70.4	70.0
27	58.0	79.7	69.0	56.5	69.2	66.5	57.4	67.9	66.8	58.0	66.7	67.7	61.2	64.0	67.0	62.8	63.0	65.4	69.5	69.2	69.1
28	61.4	82.0	68.3	57.5	71.4	68.4	57.8	69.4	68.5	58.4	67.8	68.8	60.9	64.0	67.4	62.4	62.8	65.2	69.0	68.9	68.8
29	63.2	88.0	74.0	60.4	73.8	73.8	60.6	71.7	74.0	60.8	69.7	74.2	62.5	65.6	70.2	63.2	63.9	66.8	69.0	69.0	69.0
30	64.4	66.0	68.8	64.0	65.4	68.6	64.2	65.5	68.5	64.4	65.4	68.6	65.3	65.3	66.6	65.2	61.9	65.2	69.6	69.6	69.5
31	58.0	81.0	65.0	55.9	68.4	68.1	56.5	66.9	69.0	57.3	66.1	69.6	60.8	63.5	67.5	62.5	62.5	65.0	69.2	68.9	68.7

READING OF SOIL THERMOMETERS—(*Continued*).

1891.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A M.	12 M.	6 P.M.
August 1	60.0	73.0	65.4	58.1	67.0	65.8	58.3	65.9	66.0	58.5	65.1	66.2	60.8	62.9	65.5	62.0	62.1	64.0	68.7	68.5	68.2
2	63.0	84.0	65.0	61.0	71.6	69.5	61.4	69.7	70.0	61.7	68.8	70.5	62.8	65.4	68.5	63.0	63.5	66.0	68.4	68.5	68.5
3	60.2	84.8	68.0	57.5	72.1	69.4	58.0	70.0	69.5	58.5	69.0	70.0	61.3	64.8	68.4	62.7	63.0	66.0	69.0	68.8	68.8
4	64.0	74.0	67.6	63.4	70.4	67.1	63.5	59.5	67.2	63.7	69.0	67.5	64.4	65.9	66.6	64.5	64.5	65.4	69,3	69.3	69.2
5	66.0	76.0	73.4	65.0	69.3	73.5	65.1	68.5	73.6	65.2	68.1	73.7	65.3	66.4	70.2	64.8	65.0	67.1	69.8	69.4	69.5
6	66.0	87.8	74.2	63.6	73.7	75.6	63.7	72.1	75.1	63.3	71.4	76.4	65.0	67.5	72.4	65.3	65.7	68.8	70.0	70.0	70.2
7	66.0	89.4	71.0	63.4	73.7	71.1	63.6	72.8	71.4	64.0	72.1	71.9	65.7	68.5	71.6	66.3	66.6	69.3	70.8	70.8	70.8
8	71.5	86.0	79.3	67.1	77.4	77.0	66.9	75.7	76.7	66.8	75.0	76.8	67.2	70.4	73.8	67.0	67.8	70.4	71.2	71.2	71.4
9	70.0	80.0	74.0	69.5	73.1	73.4	69.6	72.4	73.5	69.7	72.0	73.3	69.8	70.0	71.1	69.0	68.8	69.4	72.1	72.2	72.2
10	70.8	92.0	88.0	68.4	78.8	78.5	68.3	77.2	79.4	68.4	76.4	79.9	68.5	71.5	76.0	68.2	68.9	72.1	72.2	72.2	72.3
11	73.0	94.5	75.0	70.0	79.9	76.0	70.0	78.2	76.4	69.9	77.2	76.8	70.5	72.8	75.0	70.1	70.4	72.5	73.2	73.3	73.4
12	70.8	78.2	69.3	70.0	71.1	71.7	70.0	70.6	72.3	70.1	70.7	72.9	70.4	70.5	72.0	70.1	69.8	70.4	73.7	73.6	73.4
13	64.0	87.0	69.2	62.6	72.4	71.1	62.8	71.0	71.6	63.8	70.4	72.0	65.5	68.0	70.9	66.9	67.0	69.2	72,9	72.4	72.3
14	64.0	90.3	71.6	62.4	72.2	71.8	62.7	70.9	72.4	63.0	70.3	72.8	65.5	67.5	71.8	66.6	66.6	69.0	72.3	72.0	71.9
15	64.6	75.7	69.2	64.4	70.0	72.2	64.6	69.2	73.2	64.9	69.0	74.0	66.4	67.6	71.1	67.0	66.9	68.8	72.0	71.9	71.8
16	63.7	96.7	71.0	61.0	74.7	73.5	61.4	73.0	74.0	61.8	71.8	74.2	64.5	67.7	72.2	65.8	66.0	69.4	71.8	71.4	71.4
17	64.0	99.0	75.0	63.0	76.4	75.5	62.9	74.5	75.8	63.2	73.0	75.7	65.4	68.4	72.8	66.2	66.7	65.6	71.7	71.6	71.4
18	69.0	90.0	71.0	66.7	74.8	72.9	66.8	73.4	73.2	67.0	72.6	73.8	67.7	69.4	71.2	67.5	67.7	69.0	71.8	71.9	71.8
19	67.0	90.0	72.0	65.1	75.7	74.5	65.2	73.8	74.8	65.4	73.3	75.3	66.5	69.2	72.7	66.8	69.3	69.9	71.7	71.7	71.8
20	66.0	91.0	77.0	63.5	75.8	77.4	63.6	74.0	77.6	64.0	72.8	77.8	65.8	68.5	73.8	66.6	61.8	70.2	72.0	71.8	71.8
21	72.0	77.0	72.8	69.8	73.5	72.2	69.9	72.9	72.3	69.9	72.6	72.4	70.0	70.6	71.0	69.2	69.0	69.4	72.3	72.4	72.4
22	66.0	90.0	75.0	64.0	76.0	74.6	64.3	74.0	74.7	64.5	73.0	74.8	66.6	69.2	72.5	67.1	67.4	69.8	72.1	72.0	72.0
23	65.0	70.0	66.0	66.3	67.5	66.5	66.8	67.1	66.9	77.2	67.0	67.4	68.2	67.0	67.8	68.1	67.0	67.2	72.3	72.2	71.8
24	66.0	72.2	73.0	64.7	70.0	71.0	65.0	69.4	70.7	65.2	69.1	70.6	65.9	67.5	69.0	66.0	66.2	67.3	71.4	71.2	71.2
25	62.0	78.0	66.0	60.4	68.5	68.2	60.8	67.0	68.7	61.2	66.7	69.0	64.1	65.3	68.4	65.3	65.0	66.6	71.2	71.0	70.8
26	61.5	79.5	69.8	58.6	70.0	69.9	59.0	67.8	70.0	59.5	66.9	70.0	62.4	64.5	68.2	63.8	63.9	66.1	70.4	70.3	70.1
27	68.0	89.0	74.7	66.0	76.9	74.5	66.0	74.0	74.6	65.9	73.0	74.8	66.2	68.7	72.0	65.8	66.4	68.9	70.4	70.6	70.9
28	66.0	73.0	61.3	65.5	70.6	67.0	66.0	69.0	67.8	66.0	69.0	68.8	67.4	68.0	69.3	67.3	67.0	68.0	71.5	71.4	71.4
29	56.8	82.8	63.0	56.0	70.2	66.4	56.8	66.8	67.0	57.5	66.3	67.7	61.6	63.9	67.7	63.7	63.6	66.0	71.0	70.6	70.2
30	57.5	84.0	66.0	56.5	71.1	68.4	57.3	67.8	68.7	57.8	67.2	69.4	61.2	63.3	68.0	62.8	63.0	65.6	70.0	69.7	69.4
31	62.0	82.0	64.4	60.6	71.2	65.6	60.8	68.4	66.2	60.9	67.9	66.7	62.8	64.8	67.0	63.4	63.8	65.8	69.6	69.5	69.3

READING OF SOIL THERMOMETERS — (*Continued*).

1891.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
September 1	61.5	77.0	66.2	60.7	71.5	68.9	61.2	69.0	69.4	61.5	68.4	69.8	63.0	65.4	68.6	63.4	63.9	66.2	69.4	69.4	69.3
2	60.0	75.5	64.0	59.4	71.7	71.2	59.5	69.0	71.2	59.8	68.6	71.4	62.4	65.0	68.9	63.4	63.6	66.3	69.3	69.5	69.4
3	59.0	76.0	66.0	61.8	75.7	64.4	62.0	73.0	65.0	62.4	71.5	65.0	64.0	66.5	70.5	64.3	64.7	66.0	69.7	69.7	70.2
4	59.8	77.2	65.0	64.7	64.8	61.2	65.0	65.2	61.8	65.0	65.5	62.0	66.4	65.7	65.8	65.4	65.2	64.0	70.2	70.0	69.7
5	61.0	74.0	66.0	65.6	65.6	63.0	64.9	65.9	62.9	64.6	66.0	63.3	63.5	63.9	65.9	63.7	64.5	64.0	69.5	69.3	69.3
6	62.0	77.0	62.8	70.2	68.5	64.0	68.8	68.6	63.7	68.0	68.8	64.7	64.0	65.7	67.8	64.3	65.9	64.4	69.3	69.2	69.2
7	63.0	78.0	60.5	59.7	73.2	66.6	60.0	70.6	67.4	60.5	69.0	67.9	63.0	65.4	67.7	63.9	64.0	66.0	69.5	69.5	69.3
8	56.0	76.0	61.0	56.9	68.0	64.5	57.9	66.0	65.6	58.7	64.9	66.6	61.8	62.9	66.6	63.0	62.8	64.8	69.3	69.2	68.9
9	59.0	74.0	60.0	53.6	66.5	65.5	53.8	64.7	66.2	54.6	63.8	66.8	58.4	61.3	65.5	60.5	60.8	63.5	68.4	68.2	67.9
10	63.0	92.0	68.0	54.5	72.1	70.0	55.2	69.5	70.3	56.0	68.0	70.2	59.0	62.4	67.6	60.5	60.9	64.4	67.8	67.7	67.5
11	58.0	89.5	67.0	56.8	72.5	69.4	57.8	69.8	69.7	58.0	68.6	69.8	60.6	63.5	67.5	61.6	61.9	64.7	67.9	67.8	67.8
12	57.0	91.0	69.0	57.8	72.6	70.8	58.4	70.0	71.2	58.9	68.8	71.3	61.2	64.0	68.7	62.0	62.3	65.4	68.0	67.9	67.9
13	64.0	73.0	65.4	62.4	70.2	67.7	62.7	68.6	68.2	62.9	68.0	68.6	63.7	64.8	67.1	63.4	63.4	65.0	68.4	68.3	68.2
14	55.4	67.0	62.0	56.4	62.7	61.4	57.4	62.3	62.0	57.9	62.3	62.4	60.8	61.9	62.7	62.0	61.8	62.2	68.2	68.0	67.8
15	55.0	59.0	62.0	55.8	57.8	60.3	56.8	57.9	60.2	57.1	58.0	60.3	59.1	59.2	60.2	60.3	59.8	60.0	67.1	66.9	66.6
16	59.0	67.5	62.0	58.4	63.6	63.8	58.9	62.8	64.2	59.2	62.6	64.4	60.2	61.0	63.6	60.3	60.4	61.8	66.3	66.3	66.4
17	59.3	88.0	74.0	57.1	73.5	73.6	57.4	70.5	73.5	57.8	69.2	73.3	59.3	62.8	68.9	60.0	60.7	64.8	66.4	66.4	66.6
18	68.0	96.0	78.0	65.7	78.8	76.8	65.6	76.4	76.9	65.5	75.4	76.8	65.0	68.2	72.5	63.9	64.9	68.3	67.8	68.0	68.4
19	64.0	100.6	64.0	64.6	77.6	71.4	65.2	74.8	72.2	65.5	74.2	72.6	66.4	68.2	71.4	65.8	65.8	68.3	69.2	69.4	69.3
20	58.0	102.0	72.0	56.7	76.0	73.6	57.4	73.0	74.0	57.9	72.3	74.0	61.4	65.4	70.6	63.0	63.2	66.8	69.2	69.0	68.7
21	64.0	106.0	75.0	62.5	77.4	74.5	62.9	73.7	74.6	63.0	73.8	74.8	64.2	67.3	71.6	64.3	64.8	68.0	69.0	69.0	69.1
22	65.0	105.0	75.0	64.0	78.9	76.2	64.4	76.0	76.4	64.6	75.5	76.6	65.7	68.7	73.3	65.6	66.0	69.4	69.6	69.8	69.8
23	65.0	105.8	74.0	64.6	79.0	76.0	65.0	76.4	76.4	65.2	75.8	76.5	66.5	69.4	73.5	66.4	66.7	69.8	70.4	70.4	70.3
24	66.0	110.0	78.0	65.0	79.9	77.0	65.4	87.2	77.3	65.5	86.5	77.2	66.6	69.5	74.0	66.5	67.0	70.0	70.8	70.8	70.6
25	66.0	101.0	80.0	66.4	79.6	78.0	66.7	77.8	78.4	67.0	77.4	78.6	67.8	70.7	74.8	67.4	67.8	70.8	71.0	71.2	71.2
26	64.2	103.0	68.0	66.4	77.5	73.3	67.0	75.9	74.0	67.4	75.6	74.6	68.5	70.2	73.0	68.3	68.0	70.0	71.6	71.6	71.4
27	62.0	108.0	74.0	61.7	77.8	75.2	62.0	75.8	75.8	62.5	75.2	76.0	64.9	68.4	73.0	65.7	66.0	69.2	71.2	71.0	70.8
28	68.0	103.0	74.0	66.8	78.8	75.4	67.0	77.2	75.8	67.0	76.5	75.9	64.7	70.0	73.4	66.8	67.4	70.0	71.0	71.0	71.0
29	70.0	75.6	58.3	67.7	69.5	65.3	67.8	69.0	66.2	67.8	68.9	66.8	67.9	67.8	67.8	67.4	67.0	67.0	71.3	71.1	70.8
30	49.0	94.0	56.0	54.0	69.1	64.6	55.0	66.9	65.8	55.9	67.5	66.6	60.3	63.0	66.8	62.4	62.3	65.0	69.9	69.6	68.9

READING OF SOIL THERMOMETERS — (*Concluded*).

1891.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
October 1	50.0	88.0	63.0	51.1	66.3	65.7	52.6	64.4	66.2	53.5	64.3	66.5	57.9	60.5	65.2	60.2	59.9	63.0	68.3	67.8	67.4
2	56.0	97.0	73.0	56.8	70.2	72.0	57.3	68.3	72.2	57.7	67.5	72.1	59.7	62.6	68.7	60.5	61.0	65.0	67.4	67.3	67.3
3	63.0	109.0	75.0	62.4	78.4	75.6	62.5	76.0	76.0	62.8	75.5	76.0	63.7	67.3	72.2	63.4	64.2	68.0	68.0	68.3	68.4
4	66.0	90.0	75.0	65.7	75.5	73.5	66.0	74.5	73.9	66.1	74.4	74.0	66.4	69.1	71.3	65.8	66.2	68.0	69.2	69.3	69.3
5	61.0	65.0	52.0	64.5	62.6	59.4	65.2	62.5	60.4	65.8	62.8	61.5	67.0	64.7	64.2	66.4	65.1	64.3	69.8	69.8	69.3
6	50.5	80.0	49.0	53.8	62.2	57.0	54.7	60.8	58.4	55.5	61.1	59.5	58.7	59.8	51.6	60.3	60.0	61.3	68.0	67.7	67.2
7	47.0	52.7	48.5	51.0	51.0	51.4	51.8	52.0	52.0	52.8	52.4	52.5	56.3	55.3	54.8	58.0	57.2	56.6	66.3	65.9	65.3
8	49.0	59.8	50.6	50.7	54.2	52.2	51.4	54.3	52.8	51.9	54.5	53.4	54.3	55.0	55.2	55.5	55.5	55.9	64.2	64.0	63.8
9	42.0	71.0	52.0	45.0	58.4	56.0	46.0	57.2	56.7	46.8	57.7	56.8	50.9	54.2	57.3	53.4	53.7	56.3	63.0	62.8	62.6
10	42.0	74.0	54.0	46.0	60.5	57.8	47.0	59.4	58.4	47.6	59.9	58.6	51.5	54.8	58.5	53.7	53.9	56.9	62.4	62.4	62.2
11	49.0	48.0	38.0	50.5	49.0	46.5	51.0	48.5	47.7	51.5	50.2	48.4	53.4	52.6	52.0	54.9	54.0	53.5	62.3	62.0	62.0
12	32.0	68.0	43.0	38.5	52.7	49.5	39.4	50.6	50.6	40.6	51.7	51.0	46.1	49.9	52.6	49 6	49.6	52.3	60.6	60.3	60.0
13	34.0	74.0	48.0	41.3	55.9	53.0	42.5	53.5	54.0	43.0	54.3	54.5	47.2	50.0	54.4	49.6	49.8	52.9	59.4	59.4	59.2
14	38.5	73.5	54.0	42.5	55.8	54.0	43.6	53.8	53.8	44.0	54.8	54.8	48.0	50.5	54.3	50.1	50.3	53.0	59.2	59.1	59.0
15	49.0	67.0	46.0	48.5	56.0	50.9	49.1	54.2	51.9	49.5	54.6	52.9	51.4	52.4	54.3	52.2	52.3	53.8	59.4	59.5	59.5
16	45.0	48.0	47.3	46.1	47.9	48.6	46.7	48.3	49.1	47.0	48.7	49.5	49.4	49.9	50.8	50.9	50.7	51.2	59.3	59.1	59.0
17	37.0	72.0	50.0	42.5	55.5	52.6	43.6	54.0	53.6	44.4	54.8	54.2	48.0	50.8	54.3	49.9	50.2	52.8	58.6	58.5	58.4
18	43.5	72.0	50.0	45.6	55.5	53.0	46.5	54.7	53.8	47.0	55.0	54.2	49.5	51.5	54.3	50.7	50.8	53.0	58.5	58.5	58.6
19	44.0	67.0	54.0	45.4	57.1	54.5	46.0	56.0	55.0	49.4	52.1	54.5	49.4	52.1	54.5	50.7	51.0	53.2	58.5	58.4	58.4
20	48.0	48.0	47.0	49.1	49.0	48.0	49.8	49.4	48.7	51.6	51.0	60.5	51.6	51.0	50.5	52.1	51.5	51.0	59.0	58.9	57.5
21	46.0	55.0	48.0	46.5	51.0	50.0	47.0	50.5	50.5	49.2	49.9	51.5	49.2	49.9	41.5	50.0	50.0	51.1	57.8	57.7	57.7
22	42.3	46.2	36.0	44.7	46.3	42.3	45.4	46.5	43.1	48.5	48.5	47.4	48.5	48.5	47.4	49.7	49.4	49.0	57.5	57.3	57.1
23	36.0	56.5	43.0	39.4	47.2	45.4	40.2	46.2	46.0	44.7	45.8	48.2	44.7	45.8	48.2	46.9	46.8	48.3	56.2	56.0	55.8
24	40.0	61.0	39.4	42.6	49.7	45.2	43.3	48.4	46.5	46.1	47.2	49.0	46.1	47.2	49.0	47.3	47.4	49.0	55.6	55.6	55.5
25	32.0	60.0	45.0	36.5	48.9	47.5	37.8	47.4	48.0	43.2	45.2	48.7	43.2	45.2	48.7	45.8	45.7	48.0	55.2	55.0	55.0
26	46.8	59.0	54.0	46.0	52.5	51.0	46.2	51.6	51.2	46.4	51.6	51.4	47.0	48.8	50.7	47.4	48.0	49.6	54.8	55.0	55.2
27	38.0	39.0	34.0	41.4	40.3	39.4	43.4	42.0	39.6	44.0	42.5	40.7	47.2	45.2	44.4	48.4	47.4	46.5	55.5	55.4	55.1
28	34.0	53.0	37.0	37.0	44.1	42.7	37.9	43.2	43.6	38.5	43.6	43.9	42.2	43.0	44.7	44.5	44.4	46.0	54.2	53.9	53.6
29	33.0	58.0	43.0	36.1	46.6	46.0	37.1	45.5	46.6	37.8	45.8	47.0	41.5	43.4	47.0	43.8	43.7	46.7	53.3	53.1	53.0
30	39.5	58.0	51.0	41.1	50.2	50.3	41.7	49.3	50.4	42.1	49.5	50.8	44.1	46.3	49.3	45.2	45.7	47.7	53.1	53.2	53.3
31	43.4	59.0	49.0	44.1	49.5	50.1	44.6	49.0	50.5	45.0	48.8	50.8	46.2	47.5	50.0	47.0	47.1	48.7	53.9	54.0	54.0

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Yield of cream by dairy animals, monthly............................... 314
Yield of milk, average of each breed each month 94
Yield of milk by dairy animals, monthly 313
Yield of milk each month of lactation, pounds.......................... 77
Yield of skim-milk by dairy animals, monthly 313

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